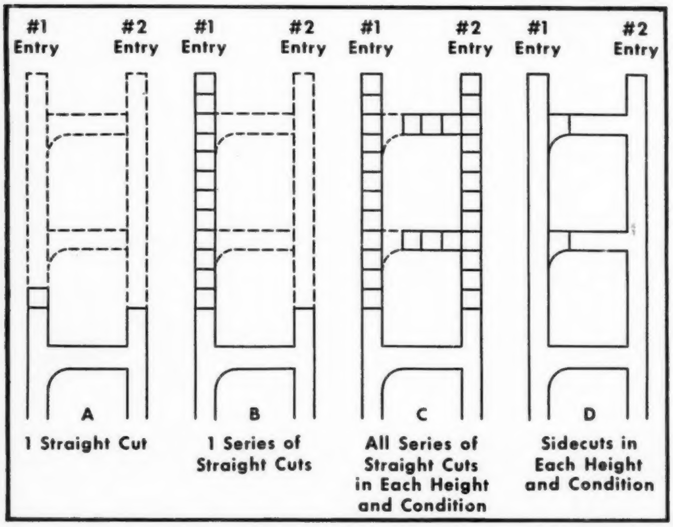
MINING CONGRESS JOURNAL

AMERICAN MINING CONGRESS

JANUARY 1961



This Red Rubber is a better rubber for runners pumping abrasive pulps because it has...

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This abrasive resistant stock is standard on all runners for DENVER SRL and SRL "Tru-Glandless" Pumps (sizes to 10" x 8"). Other polymers are available for applications involving high temperatures, oils or acids where abrasion is a secondary problem.

This permits handling coarser pulps at higher pumping speeds and heads... at lower costs!*

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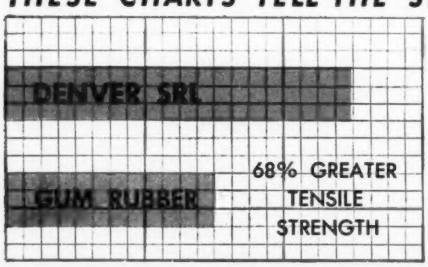

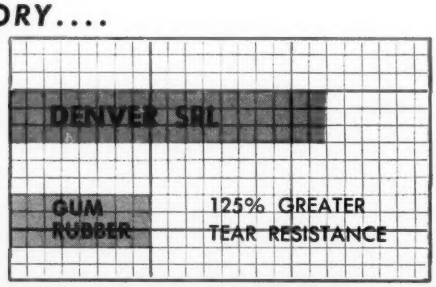

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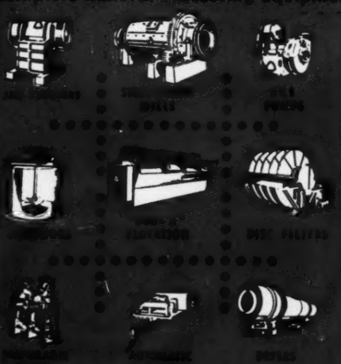
"The firm that makes its friends happier, healthier and wealthier"



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MINING CONGRESS JOURNAL

VOL. 47 JANUARY 1961 NO. 1

CONTENTS

Opinions expressed by the authors within these pages are their own and do not necessarily represent those of the American Mining Congress.

ARTICLES

SPECIAL SECTIONS

DEPARTMENTS

ON OUR COVER

January's cover illustrations highlight three articles in this issue . . . (top) Underground Drilling at Inco — (middle) Underground Planning and Control Using Electronic Computers — (bottom) Maintenance of Strip Mine Rolling Stock.

Published Monthly. Yearly subscriptions, United States, Canada, Central and South America, $3.00. Foreign, $10.00. Single copies, $0.75. February Annual Review Issue, $1.25. Second class postage paid at Washington, D. C., and at additional Post Office, Lancaster, Pennsylvania.

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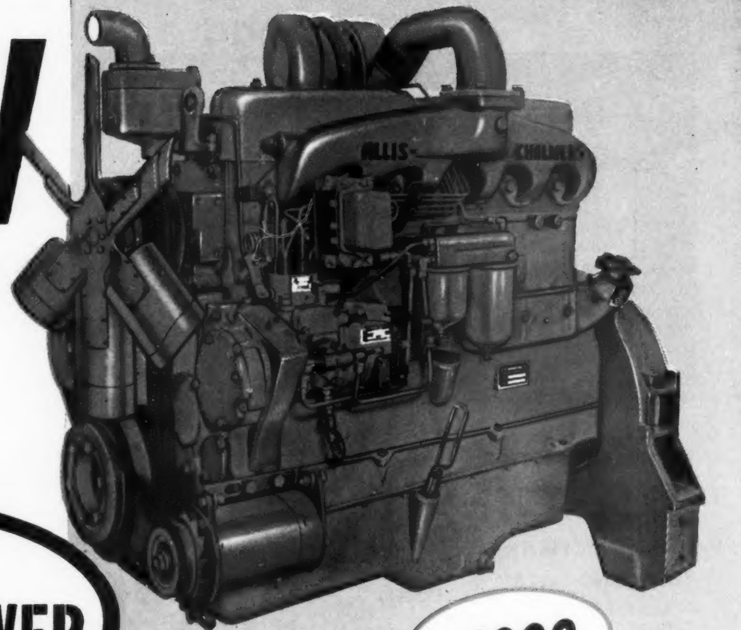
A NEW KIND OF DIESEL

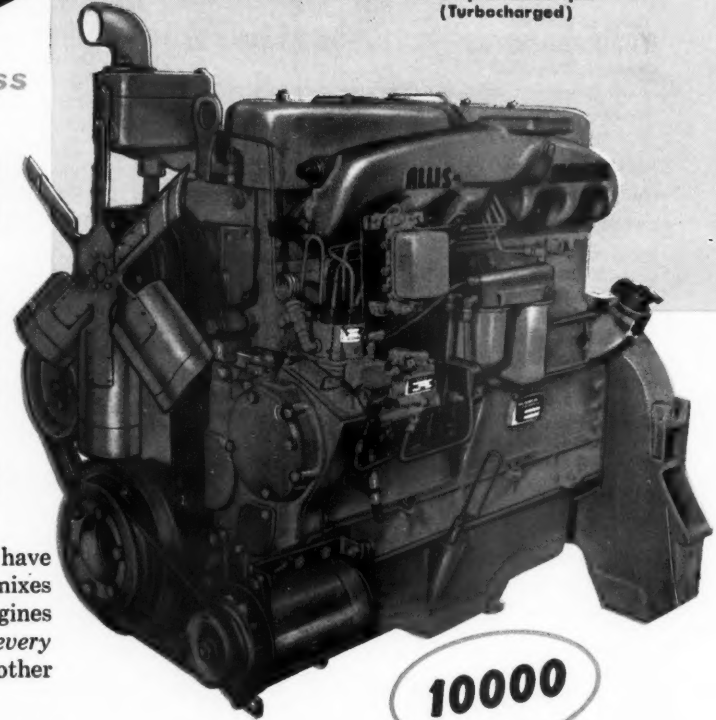
WORK POWER

in the 145—210 hp class



11000

210 hp at 2200 rpm (Turbocharged)



10000

145 hp at 2200 rpm

Nowhere is there anything like these two great new Allis-Chalmers diesels—nothing compares with them in their range!

Real Work Power — The 210 hp in the turbocharged 11000 and 145 hp in the 10000 is down-to-earth power you can use — *work* power to operate smoothly under extreme load conditions.

High, Sustained Torque gives you work power throughout the entire operating speed range — power that really hangs on.

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Clean Exhaust is another result of efficient fuel utilization in the 11000 and 10000 diesels. Fuel goes *out* in horsepower — not *up* in smoke!

Fastest Starting diesels in their class. They start without ether or pre-heating, even in freezing temperatures.

Find out more about what this new kind of work power can do for you. See your Allis-Chalmers dealer. Ask for new Bulletin BU-718. BE-23

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POWER FOR A GROWING WORLD

featured

IN THIS ISSUE—and the AUTHORS

UNDERGROUND DRILLING AT INCO

To achieve low costs and efficient drilling, Inco's well organized and capable research staff conducts a continuing test program on equipment performance and drilling methods. Important aspects of the testing program are discussed along with some of the findings relative to bit sharpening; use of integral steel; airleg, longhole, rotary percussion and jumbo applications; and drill maintenance.

MAINTENANCE OF STRIP MINE ROLLING STOCK

"Maintenance of strip mining rolling stock is everyone's business . . . and it is a cost saver, a necessary part of any profitable stripping operation." This is the theme of a report based on Truax-Traer's approach to the vital problem of maintaining stripping equipment. Full consideration is given to how mine conditions affect preventive maintenance, the subject of routine servicing, and the use of special equipment and methods to facilitate or promote good maintenance. Many practical ideas based on the writer's broad experience are included.

KRUPP-RENN DIRECT REDUCTION PROCESS

Certain iron ores which are not amenable to conventional smelting methods can be reduced in the Krupp-Renn process without the use of metallurgical coke. Experience in other countries indicates that the process can be successfully employed to prepare feed for blast furnaces, hot blast cupolas, and electric steel furnaces. The author briefly traces its history, and after giving a description, discusses applications and recent developments—both here and abroad.

SHUTTLE CAR HAULAGE AT LANCASHIRE NO. 15

In recent years, due to a step-up in productivity through continuous mining, and higher capacity with wider belts and improved track haulage, Barnes & Tucker Co. found its shuttle cars becoming obsolete. How this progressive company tackled the problem of choosing a new model—the studies made, tests run, and the final results—makes an intensely interesting story.

FIGHTING UNDERGROUND MINE FIRES WITH FOAM PRODUCING DETERGENTS

About 20 inexpensive experiments at the Cary mine of Pickands Mather with the high expansion foam plug technique have familiarized company personnel with its applications. The technique is primarily intended as a secondary fire fighting method by which many major mine fires can be averted. The foam plug tends to quench the fire by reducing the volume of air feeding it, cooling the fire area by evaporation of contained moisture, diluting the oxygen by forming water vapor, and serving as a radiation shield.

(CONTINUED ON PAGE 5)

James H. Dewey joined International Nickel Co. in 1934 at the Frood mine and subsequently served as chief efficiency engineer at both the Frood and Levack mines. In 1945, he was placed in charge of the company's drilling research program, including a diamond drill bit manufacturing shop, and in 1947 was appointed mines research engineer.

Roy M. Leseney "cut his teeth" on steam shovels in the Pittsburg, Kan., area in 1923, working for Pittsburg Boiler & Machine Co., now McNally-Pittsburg Manufacturing Corp. Since then he has served Bucyrus-Erie Co. as a field erector; Eagle-Cherokee Coal Co. as mine superintendent, and for the past 20 years has been mechanical superintendent for Truax-Traer Coal Co.

Max J. Kennard has had over 20 years experience in the minerals processing industry in engineering, operational and management capacities. He is presently vice president-engineering and construction sales, Southwestern Engineering Co. Before joining Southwestern, he was a vice president of Combined Metals Reduction Co., where he had earlier served as chief engineer and general superintendent.

Prior to obtaining his present position as general manager, John S. Todhunter served Barnes & Tucker Co. as production engineer and as superintendent of the No. 15 and No. 20 mines. He also worked for Wyatt Seanor Coal Co. as superintendent of its Seanor mine.

Bernard W. Carey has been with Pickands Mather & Co. for 15 years. He joined the company as a mining engineer on the Gogebic range of the Lake Superior District. Later, he became an assistant mining captain and then mining captain. Since 1957, he has been assistant superintendent of the Cary mine, Hurley, Wis.

(CONTINUED FROM PAGE 3) **IN THIS ISSUE—and the AUTHORS**

UNDERGROUND PLANNING AND CONTROL USING ELECTRONIC COMPUTERS

The Coal Division of U. S. Steel Corp. has simulated the mining of coal on an electronic computer in order to rapidly evaluate the effect on production of changes in conditions, equipment or methods. This simulation process is also being used for setting production standards. The author discusses the development of the mining simulation program, and describes several evaluations which illustrate the value of computers as an aid to planning.

William L. Zeller's early experience was with Warner Collieries Co. as industrial engineer, section foreman, senior engineer, and production engineer. Following this, he was a senior associate of Coal Standards, Inc., and a partner in the consulting firm of Hurley & Zeller. Since November 1957 he has been with U. S. Steel Corp. as assistant district industrial engineer for the Frick District. Along with his supervisory duties in the industrial engineering areas of methods engineering and standards development, Zeller has been engaged with the development of engineering applications for electronic computers for the Frick District.

RADIO COMMUNICATIONS IN SMALL MINING OPERATIONS

Experience at the Maybell, Colo., open pit uranium mining operations of Trace Elements Corp. indicates that inexpensive transceivers provide efficient and reliable communications that can result in reduced mining costs. Three classes of stations in the Citizens Radio Service that are available for short range voice communications are discussed briefly along with some factors that affect their utility.

A. W. Woods joined Trace Elements Corp., a unit of Union Carbide Corp., as a mining engineer in 1956 and is now mine superintendent at the company's Maybell, Colo., operations. His career in the mining industry began in 1937 at Telluride, Colo. He subsequently worked in mines in the Coeur d'Alene district, Idaho; Butte, Mont.; and Climax and Silverton, Colo. Before joining Trace Elements early in 1956, he was a consulting engineer.

BUREAU OF MINES RESEARCH IN HYDRAULIC COAL MINING

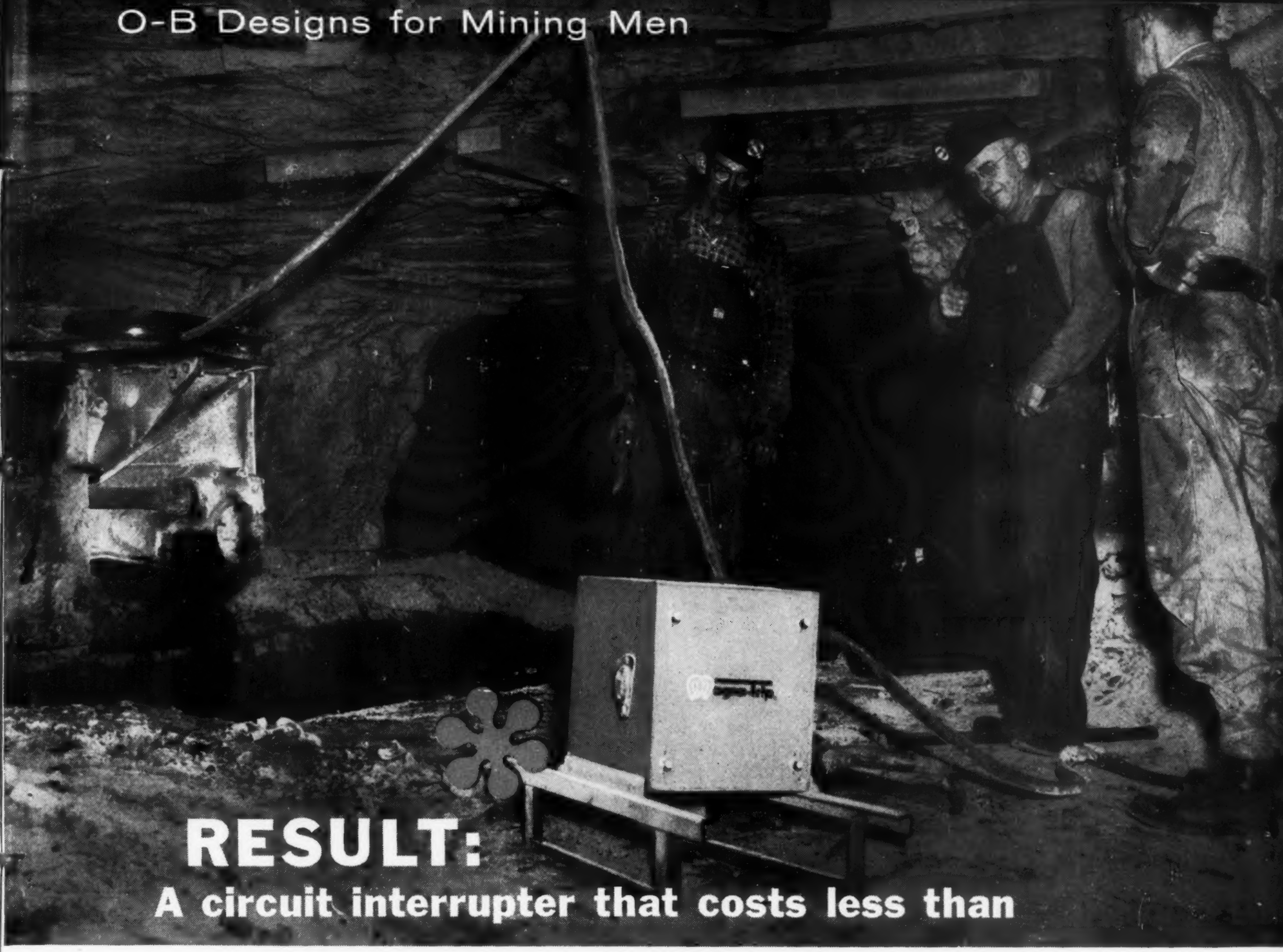
The U. S. Bureau of Mines launched an investigation in 1958 to determine if American coal beds could be mined hydraulically. Experiments were conducted in the hard bituminous Pittsburgh seam in a mine leased from Rochester & Pittsburgh Coal Co. The author presents a keen analysis of the Bureau's work to date, covering the construction and manipulation of the monitor, the tests made with different size nozzles and pressures, and the method of mining employed.

Prior to joining the U. S. Bureau of Mines, Joseph J. Wallace was employed by Pittsburgh Coal Co. as trainee, industrial engineer, fireboss and assistant mine foreman, and by Republic Steel Co. as assistant mine foreman. His 12 years with the Bureau have included work on such projects as estimating mineable coking coal reserves, roof support by cementing, and hydraulic mining. Today, he is supervising mining methods research engineer of the Bureau's Mining & Preparation Section.

RESEARCH SCIENTIST, THE CARE AND FEEDING OF

A company looking to the future must critically examine and assess its research organization if it is to make the most of the opportunities of the coming "space age." The author discusses some of the personnel and organizational problems involved and raises provocative questions to focus attention on the research function and its objectives.

Jack W. Dunlap is president and chairman of the board and executive committee, Dunlap & Associates, Inc., a Stamford, Conn., research-consulting firm. He has had a long and varied career which has included such positions as director, Bio-Mechanics Division, Psychological Corp.; director of research, Committee on Selection and Training of Pilots, National Research Council; professor, University of Rochester and Fordham University; and consultant to the Surgeon General of the Army.



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MAGNA-TRIP SNUFFS OUT SHORTS BEFORE THEY HAVE A CHANCE TO CAUSE TROUBLE. Ingenious design by O-B engineers results in a simple sturdy unit to protect machines, cables, and men. This safe control-device drastically reduces the danger and expense of cable fires.

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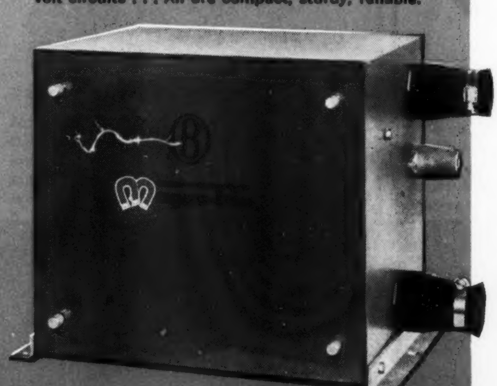
Magna-trip keeps big machines moving . . . saves cables . . . protects equipment. Units are available in 100- and 300-ampere sizes for 250 or 600 volt circuits . . . All are compact, sturdy, reliable.



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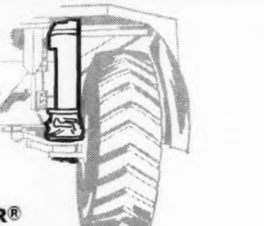
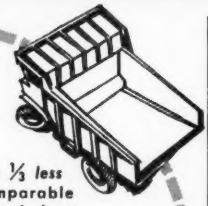


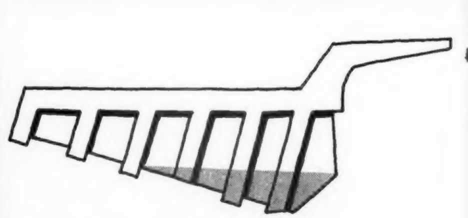
HYDRAIR® suspension

Haulpak rides on air, *not* steel. No springs, no front-axle or related maintenance. Less deadweight. High, 19 to 28-in. ground clearance, short turns. Four simple Hydrair units cushion load and road shocks, keep load riding level.



short turn-circle

Haulpak turns in ⅓ *less* space than comparable haulers, and *much shorter* than many smaller rigs. You have short wheelbase . . . and sharp-angle turn, because there's no spring or axle obstruction at front wheels.



"bonus-tonnage" V-body

Look at the extra load capacity you get within short wheelbase. Deep V-body carries up to 8 tons of material *below* normal floor-line. Center of gravity is *low*. Exhaust-heated body prevents material from sticking or freezing-in.

Is HAULPAK® different?

You bet it is!

Judge for yourself . . . compare some of these basic Haulpak "differences" against trucks you've been using:

Haulpak, for instance, is so *maneuverable, it U-turns in 1/3 less space than comparable-capacity haulers!* In fact, one owner* says: "Haulpak's short turn-around and high speeds gain us several extra truck-loads a day."

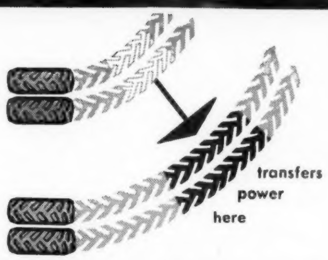
A difference in *speed?* Average top speed of the 5 Haulpak models is *32% faster than the average top speed of all other comparable-size trucks.*

A difference in *safety?* Total brake surface ranges from 3,276 sq in. on the 22-ton Haulpak to 10,186 sq in. on the 60-ton Haulpak. Compare *that* with any other hauler on the market. As another owner* puts it: "From the standpoint of safety, our Haulpaks have it all over the other trucks!"

A difference in *maintenance?* There's not a single spring to maintain on Haulpak. And *no* front axle! All parts are easy to get at; many are interchangeable. And you almost *never* have to grease Haulpak. Reports an owner*: "Haulpak has cut our truck maintenance about in half."

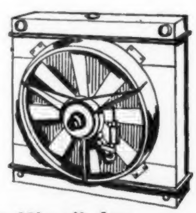
For lowest net cost per hauled ton, check the extra tons per hour, lower operating and maintenance costs *you'll* get with LW Haulpak. 5 sizes, 22 to 60 tons, up to 550 hp. More details, or a demonstration, are yours for the asking.

*Owner names on request.



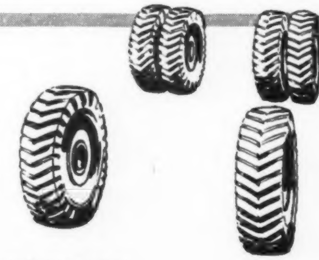
power-transfer differential

Now, for the first time on a truck, you get the LW power-transfer differential. In soft, muddy going, it automatically slows slipping wheels, transfers up to *4 times* the tractive effort to wheels on firmest footing.



"Power-Miser" fan

Alloy-aluminum radiator fan cools Haulpak engine with *less* than half the hp-drain of conventional fans. Thermostat maintains even temperature control, automatically shuts fan off when not needed, saves its horsepower for extra work-power.



interchangeable components

You operate Haulpak fleets on a *minimum* parts inventory because: All tires can be rotated to any position. Right and left wheels are readily interchanged, as well as right and left Hydrair units.

HP-2373-G-2

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Where quality is a habit

Increasing demands for higher voltages—and increasing investments in modern, high-powered machinery—demand an extremely reliable, field-proven cable. The new Anaconda AC Shuttle Car Cable fulfills these requirements.

FOR ASSURED CONTINUITY OF PRODUCTION AND MAXIMUM OUTPUT—NEW ANACONDA AC SHUTTLE CAR CABLE

Here's proof:

After two long years of severe service in the Independent Coal and Coke mines of Carbon County, Utah, Anaconda AC Shuttle Car Cable is still in excellent condition—real testimony to its reliability and long-range economy.

Since lost production due to cable failure often costs more than the original cable investment, this new cable can pay for itself many times over.

The construction features which assure reliability

1. Parallel three-phase construction which makes phase-to-phase shorts almost impossible. This flat construction also gives excellent protection against the damage of runovers. Also permits more efficient reeling. An original Anaconda design.

2. Breaker strips of tough Nylon prevent grounding wires from abrading and cutting the insulation. A patented Anaconda exclusive.

3. All Neoprene construction—results in a flame-retardant, crush-resistant cable. The first cable with all Neoprene insulation and jacket.

4. Nylon web reinforcement between cable assembly and outer jacket provides increased resistance to mechanical damage.

5. The special grounding wire construction permits the use of ground-type relay systems when desired.

All these construction features have been proved after extensive laboratory testing and tough field service.

Find out more about Anaconda AC Shuttle Car Cable. Call or write your nearest Anaconda district office, or The Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.

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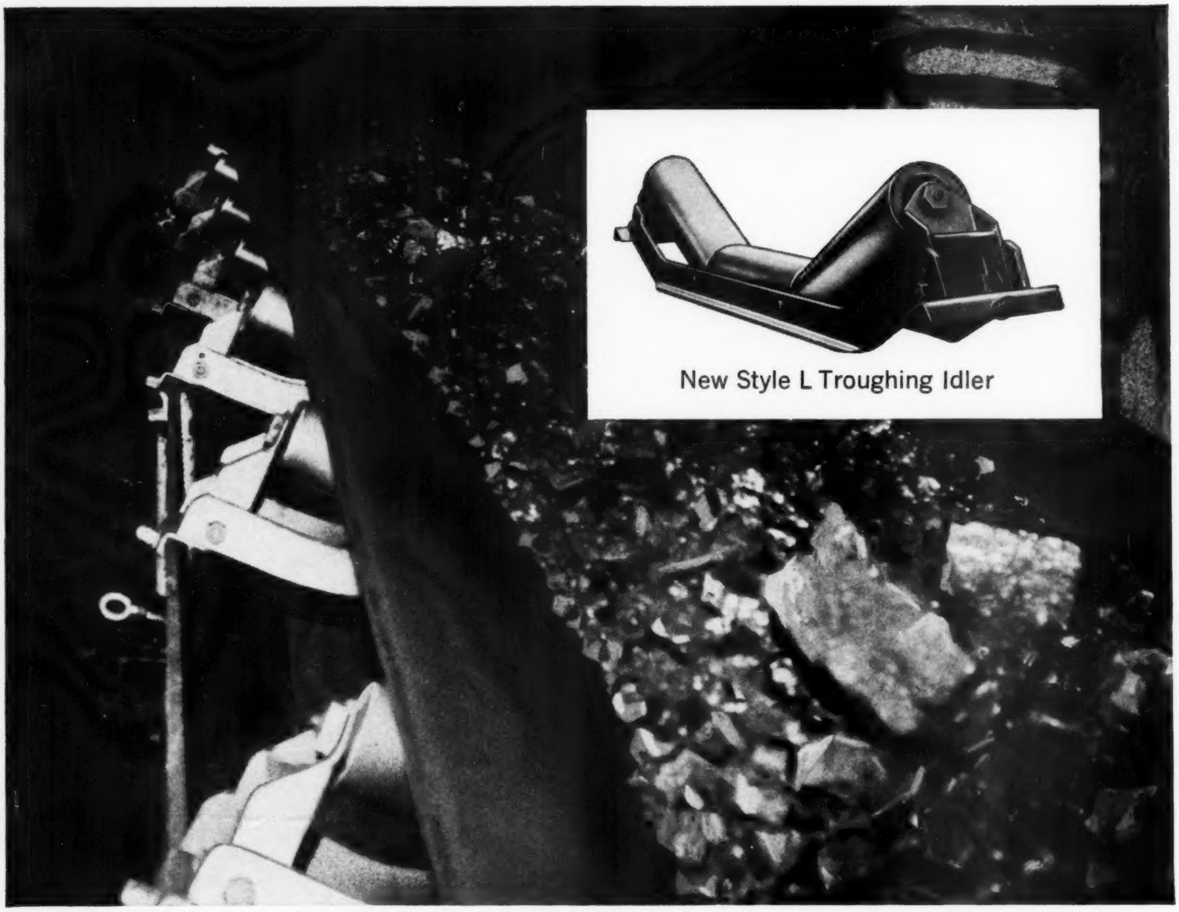
ASK THE MAN FROM

ANACONDA®

ABOUT THE NEW AC SHUTTLE CAR CABLE



New Style L Troughing Idler

Underground filmed report shows how one mine moves hard rock for less than 20¢ a ton . . .

You have probably heard of the Young Mine of American Zinc, Lead and Smelting Company and wanted to see their operation. It is believed to be one of the world's most economically-operated hard rock mines. Many have come to observe their methods, several from foreign countries. This mine operates two shifts. A total of only 95 hourly employees produce more than 3,000 tons daily. The low cost operation is the primary result of the tremendous tonnage moved by self-loading transports manufactured by Sanford-Day. Three of these S-D Transloaders, requiring only three men per shift, load, haul, and dump all the ore produced. Total cost is less than 20¢ a ton. This includes cost of original investment, maintenance and labor. Another feature of this mine that visitors observe and ask questions about with a great deal of interest is the haulage equipment. Only 28 S-D Automatic Bottom Dumping mine cars are necessary to haul the entire 3,000-ton daily production to tipple and it costs less than 4¢ a ton. We recently completed and have available now for your study a documentary 18-minute color-sound 16mm movie showing every phase of this low cost operation — from drilling to transportation of ore to mill. Ask us to mail this film to you for showing to your operating personnel . . . or, ask us to have one of our representatives bring projector and the movie to show for you. Write or call us today. Use coupon below to make mail request.

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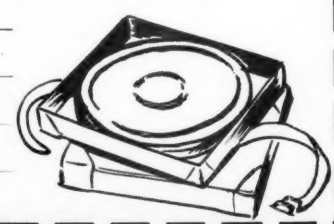


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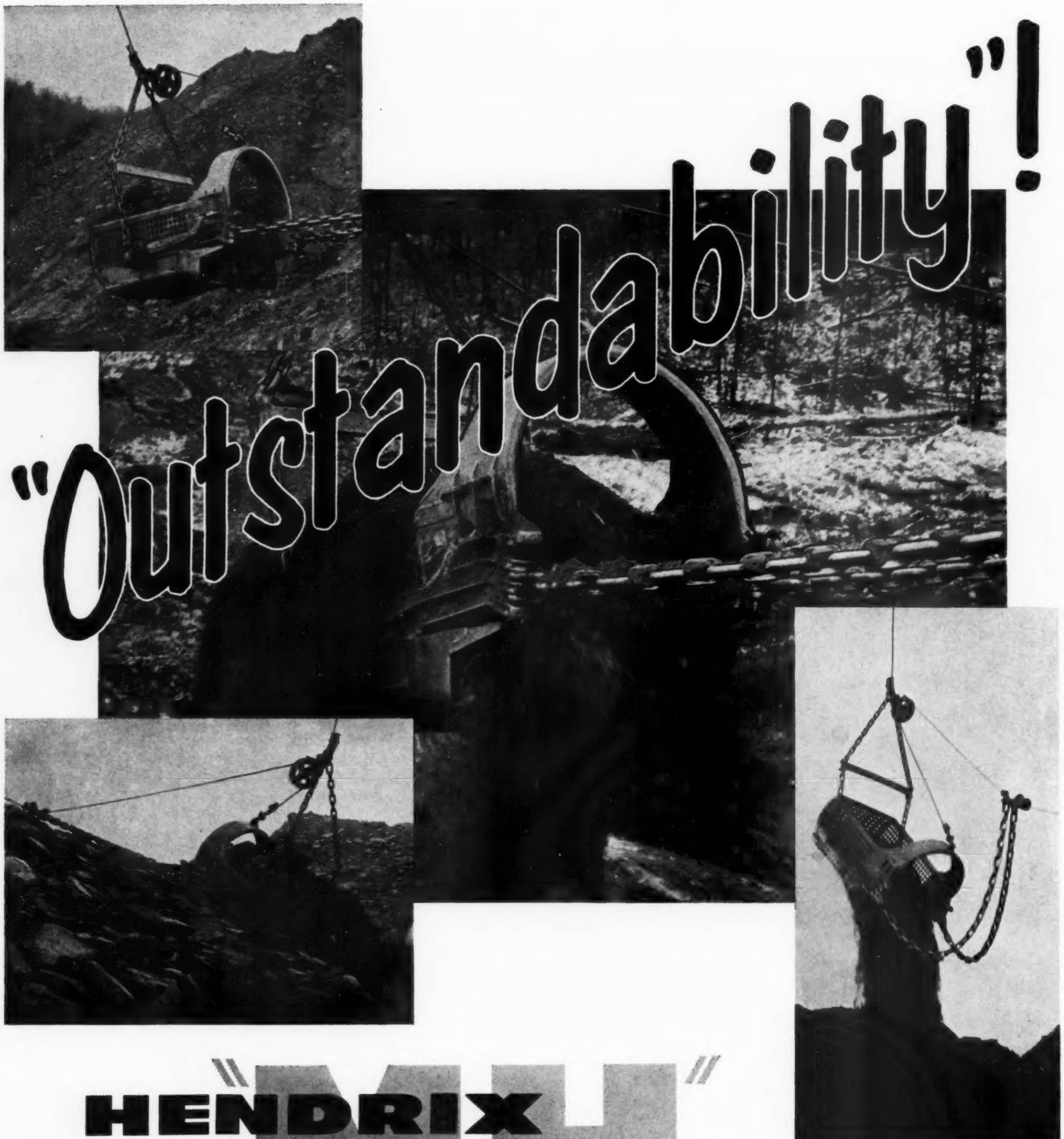

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meet all roof drilling conditions

Kennametal makes augers for various roof drilling methods—rotary and rotary percussion augers as well as augers for use with internal dust collection systems. Kennametal roof drilling augers can be ordered with full scroll, partial scroll or no scroll. Shanks on Kennametal Augers will fit any roof drill . . . and any standard roof bit will fit the auger chucks.

In addition to a *complete* line . . . Kennametal has a *top quality* line. The bodies of all Kennametal Roof Bolting Augers are made of high-strength, aircraft-quality steel tubing . . . to resist bending or breaking under the heavy strains imposed by modern roof drills.

Remember, one auger may *look* like another but . . . the difference shows up in performance. Your Kennametal Representative will gladly supply you the Kennametal Augers and Kennametal Drill Bits that will perform best in *your* mine. Call him, or contact us direct. KENNAMETAL INC., Mining Tool Division, Bedford, Pennsylvania. Phone Bedford 755. 33570

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Editorials

MINING CONGRESS JOURNAL

ROBERT W. VAN EVERA, Editor

January 1961

Image of America

The role of the engineer in overseas mining operations was discussed last month by Charles M. Brinckerhoff, Anaconda president, in a talk presented to the Sigma Xi honorary scientific fraternity at Columbia University. His message is highly significant in view of the Cuban revolution and an uneasiness throughout the other Latin American countries, and it is fortified by the remarks of Senator Mike Mansfield at the Annual Membership meeting of the American Mining Congress—covered on page 33 of this issue.

The mining industry and the engineers which it sends overseas, Brinckerhoff feels, have a grave responsibility to do everything they can to avert another disaster such as Cuba. His own company and others, he said, "cooperate with the local government on matters of public concern especially as to new investments which are sought by the government. The companies not only pay very high taxes to the government but also pay higher wages and benefits than national industries. They are constantly improving housing, medical attention and the standard of living among their employes."

In recruiting men for foreign service, Anaconda requires that they and their wives learn to "speak the language of the host country. It is a *must* for good relations and for better understanding of customs." The applicant "is given a test designed to determine his aptitude for overseas work and his ability to adjust to the new and unusual conditions which he will have to face." His wife must pass a similar test.

"We believe," Brinckerhoff continued, "that the selection of overseas employes is one of the most important parts of our responsibility. In many ways these people represent the United States to the nationals with whom they come in contact. They themselves, probably do not realize the important place they have in creating the image of the United States in some isolated part of the world. . . .

"A great concern to management in overseas operations is to find men with both the technical training and the broad humane understanding required. We have many men who are well prepared technically for management responsibility, but only rarely do we find the man who combines technical excellence with understanding of the Latin American situation and personality."

Several factors peculiar to the mining industry place its American employes on foreign jobs in a rare position to influence attitudes toward the United States. First, they are working in an industry which is basic to future economic growth. Second, their work and skills produce tangible results within the scope of observation and comprehension of foreign nationals. Third, mining engineers do their work in areas where they are likely to be the only Americans from whom the local citizens can form an image of America.

On balance, the mining industry has a right to be proud of its engineers overseas. We believe that no other professional group has been more effective in promoting goodwill for the United States on foreign soil; and the high stakes involved demand continued effort in this direction.

Mine Safety— A First Consideration

The familiar green cross of the National Safety Council signifies a movement of immeasurable accomplishment. No one knows whether lives dear to him have been saved, or to what extent his property and resources have been maintained as a result of this movement since the Council was formed in 1913. We do know that the cause of safety has made obvious advances over the past 48 years and that the work of the National Safety Council has made an important contribution to this progress.

The mining industry is well aware also of the fine educational program of the U. S. Bureau of Mines in promoting safety. While both the Bureau and the Safety Council do a splendid job of driving home the basic principles, it is of prime importance that the mining companies, their executives, supervisors and employes at all levels, meet and overcome their own safety problems.

Steady and impressive progress has been made in the field of mine safety. But accidents still occur, and as long as they do, the prevention of personal injury must continue to be a first consideration in all mining operations.

Underground Drilling at Inco

Increased efficiency and reduced costs are goals of the Drilling Research Department as it studies and reviews activities that resulted in ore production exceeding 15,000,000 tons in 1959

By J. H. DEWEY
Drilling Research Engineer
International Nickel Co.
of Canada, Ltd.

THE International Nickel Co. of Canada, Ltd., operates five underground mines and one open pit on the rim of the Sudbury Basin in the Province of Ontario, about 230 miles northwest of Toronto. Four of the mines, Frood-Stobie, Creighton, Murray, and Garson, lie on the south range of the basin within a radius of ten miles of the center of the city of Sudbury. The fifth, Levack, is on the north range about 30 miles northwest of the city.

The ores, whose principal minerals are pentlandite and chalcopyrite, are mined primarily for nickel and copper. In 1959, total ore production was over 15,000,000 tons, which was mined mainly by blasthole and fill methods with smaller amounts from caving and surface mining.

Fig. 1. Testing drill steel in a typical test panel. A test engineer supervises the drillers, controls air pressure to the drills, and times and measures each run

Airleg Drilling Method Predominant

In the company's underground mining operations in the Sudbury district, more than 16,000,000 ft of airleg drilling is done annually. This work involves 1400 machines which consume 33,000 pieces of 7/8-in. hexagonal tungsten carbide insert steel. In addition, 2,600,000 ft of hole is bored annually for blasthole mining and undercutting for caving. This requires 100 longhole machines which consume approximately 8000 tungsten carbide detachable bits, 26,000 rods and 30,000 couplings. Some BX diamond drilling is also done for special blasthole layouts requiring extra long holes. Stoping operations account for the greater portion of the drilling.

The common ore types in the nickel-copper sulphide deposits are disseminated and consist of blebs of sulphides in norite, breccia sulphide ore made up of massive sulphides with rock inclusions, and stringer ore. Rock types encountered in the ore bodies and in development mining are hard, highly metamorphosed formations of Precambrian age. These are predominantly granite, gabbro, greenstone and quartzite, which in many places are sheared and breciated.

Percussion drilling characteristics of the various rock formations are indicated by steel performance. In development rock, the footage drilled per airleg steel ranges from 150 to 250 ft, but in ore, it ranges from 300 to 700 ft. Gauge loss per 100 ft of drilling averages 0.025 of an inch. Detachable bits used in blasthole mining normally drill about 325 ft before discard.

To keep this program under constant study and review, and to increase efficiency and reduce costs through the development of new equipment and techniques, a Drilling Research Department is maintained.

Airleg Steel Testing

New types of insert steels and bits are continually undergoing trial to further improve performance. This research activity has been carried on ever since the company adopted the lightweight carbide steel and airleg drill unit some ten years ago.

Introduction of tungsten carbide created special problems in testing due to its exceptional longevity. A single carbide steel could now drill as much footage as was formerly needed for complete evaluation of a new product. Under these conditions, it was impractical to fully assess the new steel in a regular testing station as had been the practice. The most economical procedure was to use the test station for preliminary evaluation only. This could be followed, if warranted, by larger scale tests in production drilling.

In establishing a test station procedure for insert steels or bits, the first consideration is to determine the minimum quantity needed to provide reliable basic performance figures. To limit the number of steels required, the test procedure must emphasize very careful control over all factors affecting drilling. This control is maintained as follows:

(1) The test station is located in a uniform rock formation covering an area large enough to enable a direct comparison of test results over several years.
(2) Air pressure is held constant at 80 psi during all drilling.
(3) Machines are maintained in efficient operating condition by regular inspections and by rate of penetration checks.
(4) Collaring is done with mine steel.
(5) Inserts are measured carefully for dullness with special calipers.
(6) The insert is always drilled to the same point of dullness and reground to the same degree of sharpness.
(7) All sharpening is done by a test engineer trained for this purpose.

Fig. 2. Method of measuring wear of tungsten carbide insert

By observing these controls carefully, a total of ten insert steels or bits drilled to destruction provide reliable preliminary performance data.

The steel-testing station, located in an area of fine-grained, moderately-jointed greenstone, is 255 ft long. It consists of five 51-ft panels which are divided into three 17-ft sections marked "A," "B" and "C."

For a complete test, one 4-ft and one 8-ft steel are drilled to destruction in each panel. Testing is commenced in section "A," where a total of 80 ft is drilled in a vertical row of 20 holes at four-in. centers, and the same procedure is then followed in sections "B" and "C." Ground hardness is such that the maximum life of an insert is usually reached after a few holes have been drilled in section "C." Four-in. spacing between rows allows 50 complete tests in the life of the test station (figure 1).

In addition to performance figures in terms of footage per steel, statistical information recorded during the test on footage per sharpening and gauge loss provides a measure of insert hardness and resistance to abrasion.

Two drillers under the supervision of an underground test engineer are normally engaged in testing integral steel or detachable bits. These men also conduct tests on new types of airleg machines. The test engineer controls the air pressures for both machines and times and measures each run. He also sharpens and gauges the inserts (figure 2).

Product Acceptance Depends on Production Tests

Steels, which on the basis of test station results warrant further consideration, are subjected to a controlled test in regular production drilling. A development drift that is scheduled to be driven a minimum of 800 ft in reasonably uniform ground is selected for this purpose, and about 100 test steels are drilled to destruction. To provide a direct comparison in performance, an equal quantity of standard steel is used in the same heading. The test is supervised by an engineer who controls steel issues, regrinds inserts and keeps performance records.

Testing so far discussed has involved controls and has been entirely independent of the regular steel handling practices. Before standardization at all mines is contemplated, for any product which thus far has shown a potential saving, a final evaluation based on a full scale production test is conducted. In this test, partial or complete conversion at one mine is undertaken for a sufficient period of time to establish performance under regular operating conditions, and to check the uniformity of quality maintained by the manufacturer in quantity supplies.

Carbide Insert Grinding

As experience was gained in the usage of tungsten carbide insert steel, it became evident that sharpening practices would have to be thoroughly studied to effect maximum economies. To provide proven basic information on which to establish mine practices, careful studies were made of the sharpening practices followed at each mine and the resulting steel performance.

By relating sharpening practice to steel performance, it was apparent that one factor, premature sharpening, was the prime cause of low footage. This was actually the reverse of what had been expected since available literature stressed the harmful effects of over-dulling an insert, but made no mention of serious effects from premature sharpening. The supplier's instructions at the time were only that the dullness of the cutting edge should not be allowed to exceed 3 mm at a point 4 mm from the outside edge, and that the normal cutting edge should be restored up to this point in regrinding (figure 3).

A test station investigation was undertaken to obtain a more thorough understanding of the optimum dullness to which an insert should be drilled and the degree to which it should be sharpened.

Three procedures were selected for the test (figure 4). In Test 1 the steel was run until the insert, at a distance

of 4 mm from the outside edge, had reached a measured dullness of 1.5 mm or what on the basis of the supplier's recommendations could be called the half-dull point. The normal cutting edge was then restored. This procedure was repeated until the insert failed.

In Test 2 the steel was run to a measured dullness of 3 mm, the maximum amount recommended, after which the cutting edge was resharpened to normal. In Test 3 the steel was also run to the maximum dullness of 3 mm, but was resharpened only to the half-dull point, 1.5 mm. Stated briefly, the drilling in Test 1 was done from sharp to half dullness, in Test 2 from sharp to maximum dullness, and in Test 3 from half sharp to maximum dullness.

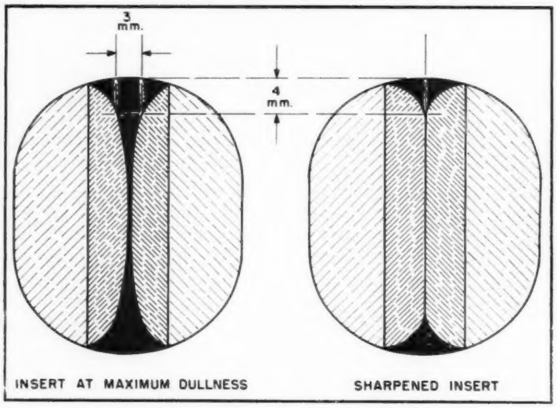


Fig. 3. Face views of insert showing original sharpening practice. When the cutting edge reached three mm in width at a point four mm from the outside edge (left), the insert was sharpened as shown at right

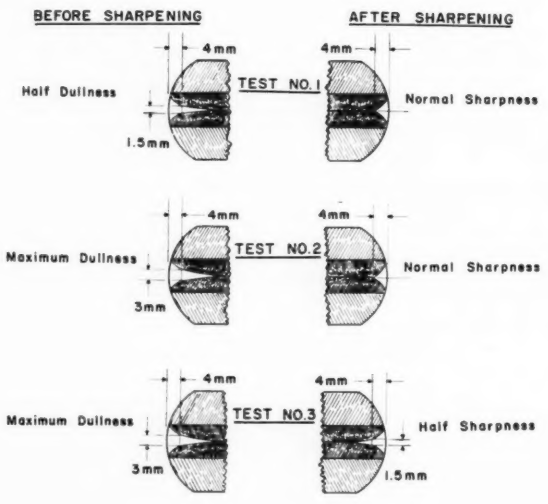
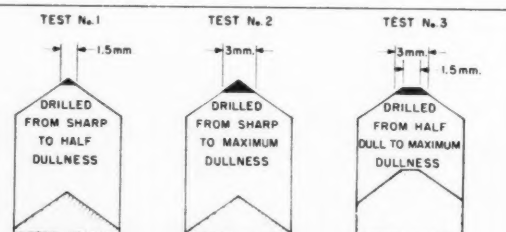


Fig. 4. Sharpening practices followed in three steel destruction tests that were undertaken to find the optimum dullness to which inserts should be drilled and the degree to which they should be sharpened



TEST RESULTS

	TEST No. 1	TEST No. 2	TEST No. 3
Total footage per steel	35	102	182
Footage in % of normal (Test No. 2)	34	100	180
Total number of sharpenings	19	10	16
Average feet per sharpening	1.8	10.2	11.3
mm. of insert height used	10.1	10.3	7.8
Feet drilled per mm. of insert height used	3.5	9.9	23.3

Fig. 5. Results of the steel destruction tests showed that insert life could be increased 80 percent when the insert was sharpened only to the half-dull point as in Test 3. Premature sharpening decreased insert life 34 percent of the performance obtained when following recommended sharpening practice

Results (figure 5) showed that premature sharpening, as in the case of Test 1, decreased insert life to 34 percent of the performance obtained from the recommended sharpening practice followed in Test 2, whereas an 80 percent increase was obtained by the practice of sharpening to the half-dull point only as in Test 3.

A theoretical explanation is illustrated in figure 6, which shows a cross section of an insert through a point 4 mm from the outside edge. Assume BC to represent the cutting edge when half-dull and DE when fully dull. By geometry, all four triangles shown in the area ADE are equal. Only one-quarter of the volume of carbide is worn away in drilling from the sharp to half-dull point compared to three quarters when from the half-dull point to full dullness. The decrease in drilling speed between these two stages of wear was only six percent in the tests conducted.

Four Steps in Airleg Test Procedure

Airleg machines have undergone a number of modifications since they were first brought into Canada from Sweden in 1948. The original yoke-type leg connection, which was troublesome and costly to maintain, has been replaced by a direct connection to the cylinder. On most models, the feed valve has been transferred from the leg to the handle for ease of operation.

All manufacturers have attempted to "speed-up" their machines by enlarging cylinder bore and general refinements in design. To evaluate the modifications offered from time to time, and to maintain optimum drilling efficiencies, special drill testing procedures were established.

As with drill steel, new types of airlegs are put through a series of tests for complete appraisal. The first step is to determine the rate of penetration and handling characteristics. This is done in a section of the test station adjacent to the steel test panels. A drill must show a reasonable improvement in one or both of these characteristics.

The next step is to determine the effect of the drill on steel life since an increase in penetration rate is usually accompanied by a drop in steel performance. A faster drill would be unacceptable if the anticipated labor saving were more than offset by higher steel cost. On the other hand, some allowance may be made for continuing improvement in the quality of steel which would minimize any adverse effect of a faster drill on steel performance.

In a third test, the adaptability of the machine to the various mining methods and ground conditions is assessed through use in regular production operations. The miner's reaction to the drill is also noted at this stage.

The fourth and final step, before general standardization is considered, is to establish maintenance characteristics. This involves placing up to 30 machines in regular mining for a minimum of six months.

In addition to the testing of airleg steels and machines, a program to improve performance of longhole drilling equipment is being conducted.

Since longhole drilling does not lend itself to the use of a test station, tests are made in the course of regular mine operations by selected production drillers. The program is supervised by a research department driller who also operates a production machine on a test basis. Normally, the assistance of three or four production personnel is sufficient to keep abreast of the latest developments and maintain a quality control over standard equipment.

Most Drill Repairs Completed in Underground Shops

Inspection and maintenance of rock drills is the responsibility of a drill repair foreman and a staff of fitters who also maintain air hoists, mechanical loaders and associated miscellaneous equipment.

Each mine has a surface drill repair shop conveniently situated near the main hoisting shaft and other service buildings, and a number of underground repair shops (figure 7) located strategically throughout the mine. Drill fitters are assigned to various divisions of the mine on each regular production shift.

Most repairs are completed in the underground shops, but when precision grinding, welding or other special work is required, the machines are sent to surface. Repairs to longhole drills are usually performed on location to avoid delays in transporting the heavy machines. Spare airleg machines and stopers are kept available in the underground repair shops.

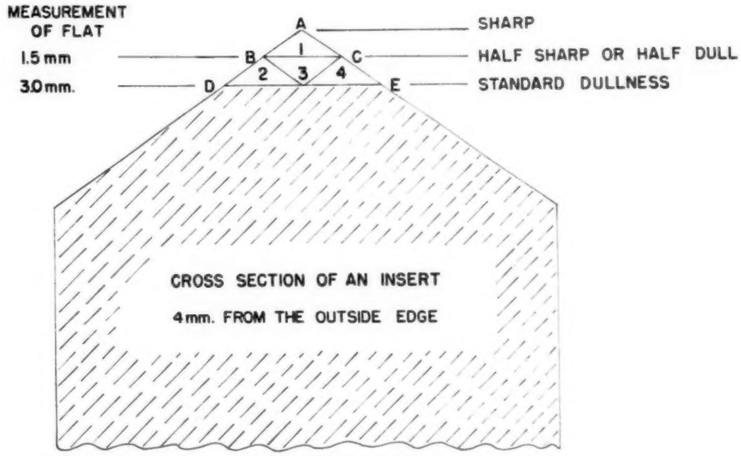


Fig. 6. Only one quarter of the volume of carbide insert is worn away in drilling from the sharp to half-dull condition compared to three-quarters from the half-dull to full dullness. In the tests conducted, drilling speed decreased only six percent between these two stages of wear

The point at which repairs to rock drills become uneconomical has been determined by tests and experience to be almost entirely dependent on cylinder wear. Maximum wear for airleg drills has been established as 0.0035 in.; for stoper drills, 0.004 in.; and for longhole drills 0.006 to 0.008 in. At this point of wear, the sum of the operating cost plus depreciation is in favor of the replacement of the drills.

Drills which are approaching termination of their useful life, as indicated by general condition and length of service, and which are not performing efficiently, are sent to surface for inspection by the drill foreman. If cylinder wear has reached the maximum allowable and general condition otherwise is poor, he will scrap the machine and salvage usable parts.

The foreman is responsible for issuing replacement parts to the underground repairmen, inspecting damaged parts, and keeping a complete record of repairs for each drill from the date of issue until scrapped. Each machine is numbered and a daily report is issued by the shift boss on the machines operated. Drilling footages, calculated from survey measurements and standard performance data, are used in computing monthly, quarterly and yearly drill repair costs.

Research and Development

New mining practices have been developed and put into operation at Inco as a result of test programs and cooperation with manufacturers in designing new equipment.

Longhole Drilling—Longhole drilling

Fig. 7. Repairing a drill in an underground shop. Machines are generally sent to the surface only when precision grinding, welding or other special work is required. Repairs to longhole drills are usually performed on location

is one phase of operations which has benefited substantially from constant research. Machines available for drilling longholes at the time of this major innovation were underpowered, limiting the depth and size of drill hole on which mining layouts could be based. Performance also suffered from the poor quality of accessory equipment such as extension rods, couplings and bits. Rapid progress was made in overcoming these initial problems, however, and the practicability of the new method was soon firmly established.

Blasthole stopes are mined by drilling rings in a vertical plane from regular seven by seven-ft pillar crosscuts. The maximum length of rod that could be used in these crosscuts with the original design of longhole drill was three ft.

Early studies indicated that drilling efficiencies would improve considerably if the time spent in adding and removing rods was reduced by using longer rods and a mechanical means of uncoupling. To accommodate longer rods, drill crosscuts could have been driven larger, but this would have increased development costs and made it necessary to maintain more open ground. The problem was finally solved when the manufacturer modified the machine design so that four-ft rods could be used. The feed motor was moved from the back of the machine to an underslung position at the rear of the shell (figure 8).

Rotation Assembly Modifications

The new model also featured important changes in the rotation assembly by which the rods could be turned in the opposite direction or rotation discontinued altogether. The reverse feature provided an efficient mechanical method for disconnecting rods, and neutral rotation enabled removal of stuck rods which formerly would have been abandoned.

Further advances in longhole drilling efficiencies could be foreseen through the use of more drill power to increase penetration rate and hole depth, although this would have to be accomplished with very little additional weight if a one-man drilling operation were to be maintained. The drill manufacturer's answer was a new machine with a 4½-in. cylinder bore which provided 30 percent more power at a weight increase of 56 lb.

Efficiency was improved substantially with the new machine making possible important changes in drilling layouts. Long up-holes, formerly impractical, as well as longer down-holes could now be drilled efficiently. This led to the elimination of sublevels (figure 9), and as a result, stope development costs were reduced as well as the time required to prepare new blasthole sections for mining. The elimination of sublevels also lowered supply handling and level maintenance costs and simplified supervision.

The advisability of increasing the size of hole, made possible by the additional power, was considered next. In the past, it had been necessary to limit bit size to the minimum that would provide free clearance of sludge past the drill string. Use of larger bits would increase the cost per foot of hole drilled, but, since less footage should be required, a net saving might be possible. An investigation was undertaken to see if economies could be effected by increasing bit size from 2⅛ to 2½ in.

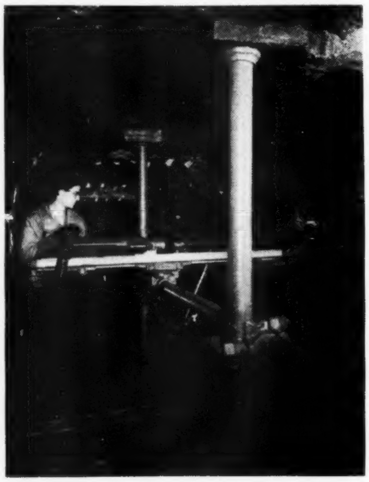


Fig. 8. Longhole drilling in a seven by seven-ft crosscut. Placement of the feed motor in an underslung position at the rear of the shell meant that longer drill rods could be used without increasing the width of the crosscut

Small scale tests with the larger bit showed that drilling costs did not increase in proportion to hole volume.

To obtain comparative over-all costs for the two sizes of holes, including secondary blasting and ore removal as well as primary drilling and blasting costs, large-scale tests were conducted in a number of blasthole stopes. The lowest over-all costs were obtained with the regular 2⅛-in. bit. The 2½-in. hole provided a less favorable powder distribution, resulting in poor fragmentation with high secondary blasting and ore removal costs which more than offset the initial saving in drilling and primary blasting.

In establishing optimum hole size the following factors must be considered: (1) Drilling cost per unit volume of hole, (2) powder distribution, and (3) fragmentation required for efficient use of removal facilities.

Airleg Drilling—When airleg drilling was first introduced at Inco, it was found that, in addition to other advantages, satisfactory fragmentation could be obtained with the smaller holes and powder without increasing the number of holes drilled. The possibility of economies through further reductions in hole size then led to extensive tests in regular stoping operations.

In these tests, the standard ⅞-in. hexagonal insert steel and one-in. powder were replaced by ¾-in. hexagonal steel and ¾-in. powder. Hole size was reduced from 1.26 to 1.02 in. Results in all tests were unfavorable to the smaller hole due mainly to excessive rod breakage. More holes were required for proper fragmentation with the ¾-in. powder even though it was found possible to reduce the powder factor slightly. Explosive costs were higher, however, because of the extra caps and fuse required. The advantage in drilling labor obtained through an increase in rate of penetration with the ¾-in. steel was offset by the additional number of holes drilled. Denser loading, to avoid extra holes, would effect an improvement in drilling labor and explosive costs.

In the study of airleg steel, the relative merits of detachable bits and insert steel have been under investigation on several occasions. Final results in all instances have favored the insert steel. This is contrary to the general practice in the United States which tends toward the use of detachable bits and larger holes in the softer rocks encountered there.

Auger type drill steel, which has been tested with airleg machines for drilling in badly fractured ground, has shown definite promise. The spiral-shaped rod works small pieces of loose rock from the hole and seals the wall with a coating of sludge. Costs have been unacceptable due to the relatively short drilling life of the plain carbon steel rods, but manufacturers have advised that new techniques for fabrication of auger steel with alloys are under study.

Constant expansion at Inco, often requiring rapid development of new mining areas, has led to a continuing demand for accelerated drift advance. The trend initially was toward the use of jumbos, and a five-boom drill carriage with Leyner machines using

integral steel was designed for high speed drifting. Efficient operation, however, involved constant attention to jumbo maintenance, which was costly and not always feasible.

The final outcome was the development of a drilling truck designed for use with five airleg machines. Maintenance and delays are virtually eliminated since a drill can be quickly replaced. Two machines are operated from an elevated and extended platform on the truck and three others at drift level beneath. The machines remain connected to common air and water outlets on the truck and can be put into operation or removed from the face as quickly as with the jumbo. Similar trucks have been designed for regular drifting operations. They are fitted for three drills, and a spare machine is in readiness in the event of a failure.

Rotary Percussion Drilling — Rotary percussion drilling, extensively used in Europe, proved disappointing when tested in the harder rock formations at Inco. Bit costs were extremely high, due to early failure of the insert, and penetration rates were little better than with airleg drills. The weight of the machine also proved a disadvantage. Major modifications in drill design would be necessary to make rotary percussion drilling an efficient tool in hard rock formations.

Future Drilling Equipment

Important economies can be seen by developments that would enable still further reductions in hole size. New steels would have to be developed possessing greater fatigue strength yet compatible with forging and heat treating processes. Smaller drills striking lighter and more rapid blows, which would be more suitable to the performance of lighter steels and less fatiguing to handle, would also have to be designed. Other helpful factors would be more powerful explosives and methods for denser loading.

A large saving in labor would be possible by the use of such light machines and steels supported by a framework of mountings designed for mass drilling of development rounds by a single operator. Mountings on the framework would provide one machine for each hole to be drilled and could be arranged to a pre-determined pattern. The drills would be equipped with a multistage telescopic stoper-type feed to restrict weight and bulk and provide sufficient travel for long holes to be completed with a single steel. The mountings should be simply constructed for easy replacement of a drill in the event of failure. A special device, possibly a template, would have to be developed for collaring.

With a multiple drill unit, it would be possible to drill out an entire round in little more than the time now required for a single hole. The unit would be easier to maintain than power jumbos and capital cost would be less. Similar rigs could be designed for other development work such as raising and sinking.

Directly the opposite of a multiple drill unit would be equipment for complete removal of development rounds by drilling a single large hole. Machines are already in use in Europe for drilling holes of this nature in softer formations and extensive research is now being carried on by manufacturers to design similar equipment for hard rock drilling.

Underground hard rock rotary drilling equipment, which would drill 12 to 16-in. holes 200 ft long, would make it possible to replace costly stope raises where hydraulic fill is used. This would yield important economies in development costs and also eliminate bad ground conditions frequently caused by the raise opening in the stope backs. The drill hole, when not being used for hydraulic fill, would provide a stope ventilation outlet by installing an exhaust fan at the collar. Supplies and services would be provided from the level below.

A movable platform for use in cut-and-fill stoping, which would enable both drilling and mucking to be carried on independently of each other, is regarded as a logical future development. The platform, power-equipped for movement to and from the breast, would probably be suspended from some form of track which could be readily advanced after each blast. The platform could also be used in roof bolting and scaling high backs.

Longhole drill performance would be improved by a mounting which would hold the machine in direct alignment with the drilling forces. With the present mounting, these forces tend to push the machine out of alignment causing excessive drill maintenance and rod damage and creating heavy vibration, which reduces rate of penetration and general performance. Other improvements in longhole drilling operations would be a light drill carriage for use in small blasthole drifts to reduce move and set-up time, and increased automation to enable multiple drill handling.

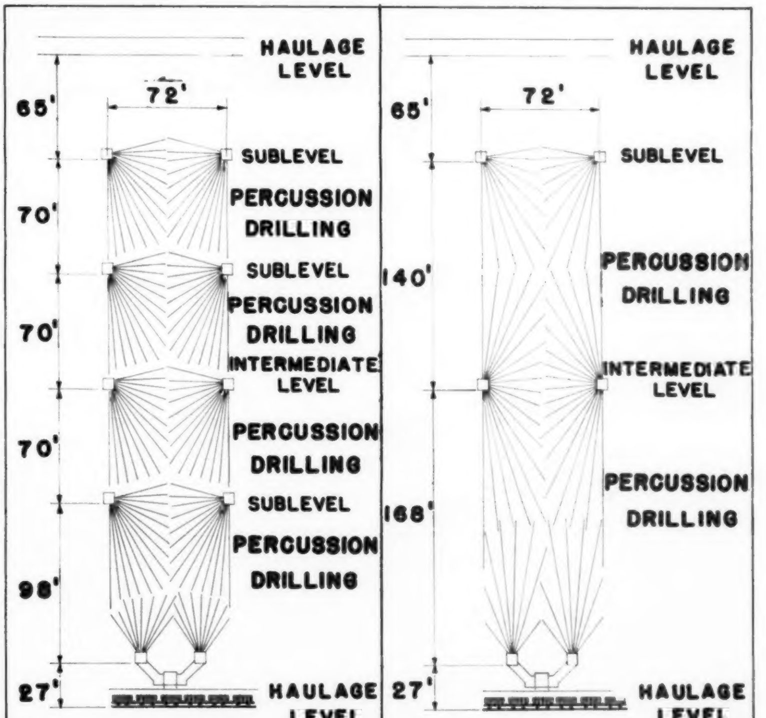
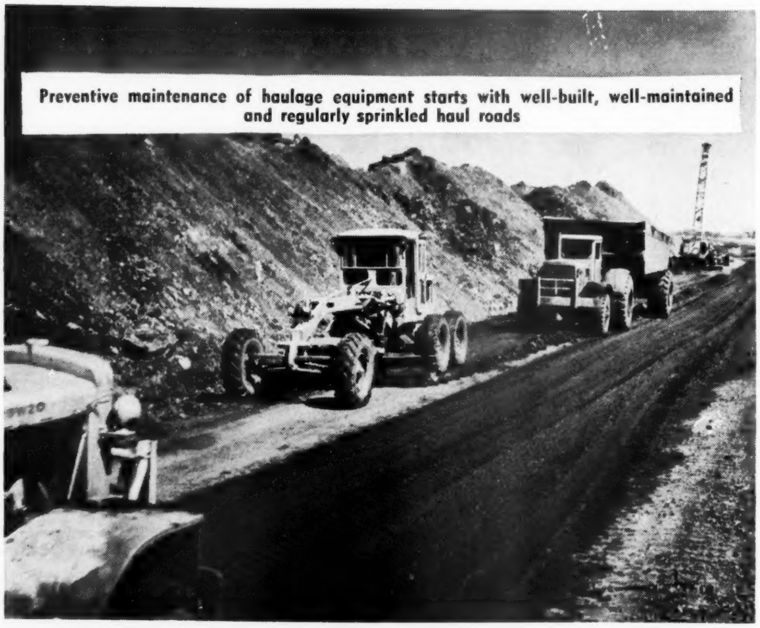


Fig. 9. Development of more powerful longhole drills led to elimination of sublevels in blasthole stopes since longer holes could be drilled. This in turn reduced development costs, lowered supply handling and level maintenance costs, and simplified supervision

Maintenance of strip mine rolling stock

A thoughtful, well-planned maintenance program is a cost saver

By ROY M. LESENEY
Mechanical Superintendent
Truax-Traer Coal Co.



Preventive maintenance of haulage equipment starts with well-built, well-maintained and regularly sprinkled haul roads

FIRST, let us define the word "mobility" as it is related to strip mine equipment. Normally, only trucks, tractors, hauling units and the like are thought of as being "mobile" or "rolling." However, practically all mine equipment falls into this classification to some extent. Even large shovels enjoy a certain amount of mobility and, perhaps more important, the procedures for maintenance are similar in most cases to those for the more highly mobile units. Thus, the broad view of mobility will be taken.

In a similar way, let us also define the word "maintenance" in a broad sense . . . to include not only preventive maintenance but also repair work.

With this in mind, further remarks on maintenance will be divided into four general areas: (1) mine conditions, (2) routine servicing, (3) special adaptations and equipment, and (4) maintenance philosophy.

How Mine Conditions Affect Preventive Maintenance

The first area, mine conditions, is normally considered within the production or safety areas of mine management responsibility.

Thinking in larger terms, one of the best forms of preventive maintenance for stripping equipment is a well-shot high wall. And this is particularly true in mines using large, lightweight dippers fabricated from T-1 steel. With the introduction of ammonium nitrate and rotary air-blast drills, the price of a well-prepared high wall is cheap preventive maintenance . . . and the almost certain increase in production is an added bonus.

Along the same line, preventive maintenance for haulage equipment starts with well-built, well-maintained, and regularly sprinkled haul roads. Truax-Traer Coal Co. tries to avoid having grades on its properties that are over four percent.

Good road building material is hard to find around a strip mine, but Truax-Traer generally uses fire clay, which is under the coal, and shale from just above the seam. A mixture of these materials is spread with bulldozers, smoothed with motor graders, compacted with haulage units, and finally topped with a layer of crushed limestone. The amount of limestone depends on road conditions and is added from time to time as needed.

The lesson in this is simple but easily forgotten—haulage equipment lasts longer without expensive repairs if it travels over smooth, dust-free roads. Air cleaners are more efficient and require less servicing, which means less dirt enters the engine to cause rapid valve and ring wear. Also, smooth, moist roads cut tire repairs by lowering tire temperatures.

With most mines going to larger haulage units, this form of preventive maintenance is even more important because when a large unit is down, the percentage of lost tonnage is greater.

A third example in this first broad area would be facilities for proper storage of electrical equipment, particularly d-c motors and generator armatures. Electrical apparatus, if improperly stored, has a much shorter service life and often fails immediately after installation.

Routine Servicing — Emphasis on Inspection and Lubrication

The second broad area, routine servicing, includes a strict program for changing oil and servicing oil filters, fuel filters and air cleaners.

The frequency of oil change depends upon conditions encountered at each mine, but 150 to 200 hours is the

The men who operate the equipment can do their part to prevent serious breakdowns by reporting such things as cracks and unusual noises

rule at Truax-Traer's operations.

Similarly, the company keeps a close watch on fan belt tension. On most engines, the fan belts run the water pump and a slipping fan belt can lead to overheating of the engine and damage to cylinder liners and valves. A five-minute adjustment can save a several hundred dollar repair bill. To further assure adequate cooling, a water conditioner is used in the cooling systems winter and summer.

Maintenance of the crawlers on track-type tractors is a subject in itself but observance of a few guide posts will greatly increase life of track components.

1. **Every shift should begin with a thorough lubrication of the machine by the operator. This includes checking the crankcase oil and radiator water levels.**
2. **Keep tracks at proper tension . . . about 1½ in. of slack above the carrier rollers.**
3. **Have operators make gradual turns. Sharp turns increase wear to track shoes, links, bushings . . . all track parts . . . and the time saved by fast turns cannot begin to pay for the cost of replacing track parts prematurely.**
4. **Utilizing a few minutes before the end of each shift to clean mud from track rollers will lengthen their life. In winter such cleaning will prevent the overnight freezing which leads to flattening of the roller surface on which the rails travel.**

To get the most from rails and rollers, Truax-Traer builds them up once—but only once because too many broken links are experienced after a second rebuilding. The company generally gets about 3000 hours from a new set of links and 2500 from the rebuild.

In welding T-1 steel, Truax-Traer has encountered no serious problems; it uses the correct, low-hydrogen rod, with a reasonable amount of precaution, and generally stringer beads. Preheating of thick lips and other heavy sections is no doubt best but the company seems to get along with a minimum amount of preheating and just enough peening to clean out the slag.

Building up dipper teeth still poses problems and in an effort to solve these, some mines are successfully using semiautomatic machines with bare wire, However, if this work can be detailed to the same one or two welders, results will be more uniform and there will be a better chance of determining what causes weld failures. The writer finds most failures are caused by using incorrect rods or improper techniques.

One other area offers the maintenance supervisor an opportunity to speed repairs and cut down-time costs. Truax-Traer tries to keep rebuilt units on hand, such as engines, transmissions, cylinder heads, fuel pumps, air compressors and shaft assemblies for stripping and loading equipment, just to name a few. Generally, less time is required to change the entire unit than to keep a piece of equipment out of service while the unit is being torn down and reassembled.

For example, the night shift will change cylinder heads on a truck engine, making the truck available for the coal run the next morning. The cylinder heads can then be repaired on the day shift, or sent to the equipment dealer's service shop.

Even though Truax-Traer has a fairly complete shop at each property, management feels it is best to send major engine rebuild jobs to dealer service shops.

Along this line, the company welcomes service schools from manufacturers and visits by lubricating engineers and wire rope engineers. They help keep the company out of difficulties.

Special Equipment Facilitates or Promotes Good Maintenance

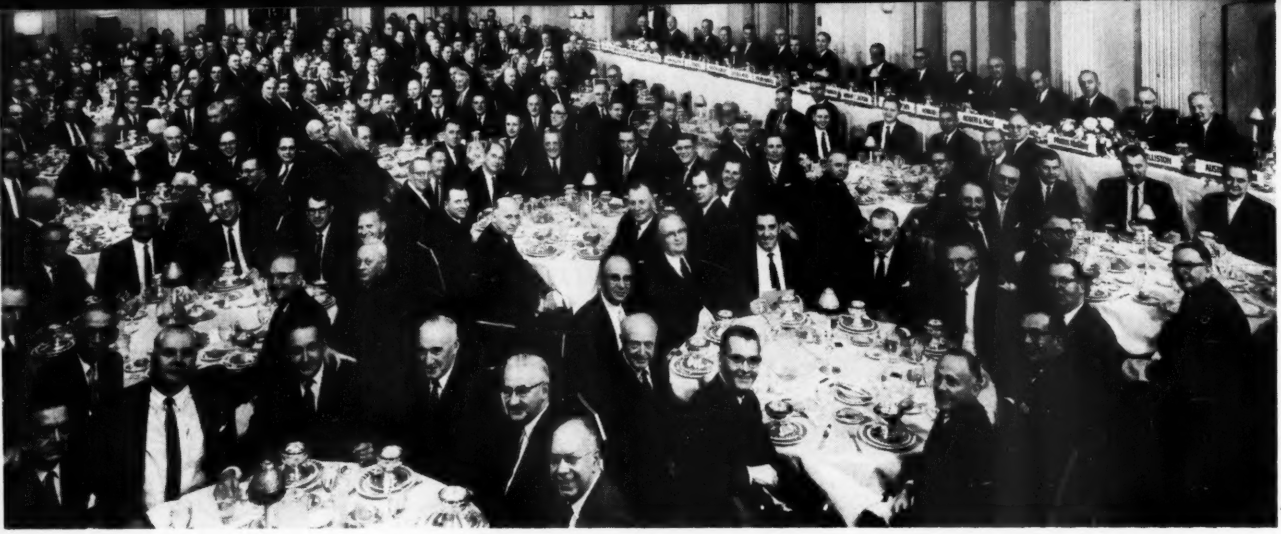
The company does a number of things on its own, however, to keep out of difficulty and speed the work. This is the area of special adaptations and equipment.

One interesting piece of special machinery is a portable magnet mounted on a two-wheel trailer and pulled by a farm tractor, jeep or whatever is available. Periodically, the haul roads are gone over with this magnet to pick up welding rod ends, nails, bolts, nuts, and even old railroad spikes. The 18 by 48-in. magnet is activated by an air-cooled motor driving a 115-volt, 17.5 amp generator. This little rig has paid for itself many times over in reducing tire damage.

One of the company's garage foremen came up with another idea. On diesel engines using PT fuel pumps with electric shutoff, he connected a spring-loaded, normally-open switch across the terminals of the lube oil

(Continued on page 37)

Cleaning the mud from track rollers before the end of each shift will lengthen their life



AMC ANNUAL BUSINESS MEETING

Hon. Mike Mansfield, Senator from Montana, Discusses Foreign Policy, Including the International Gold Situation

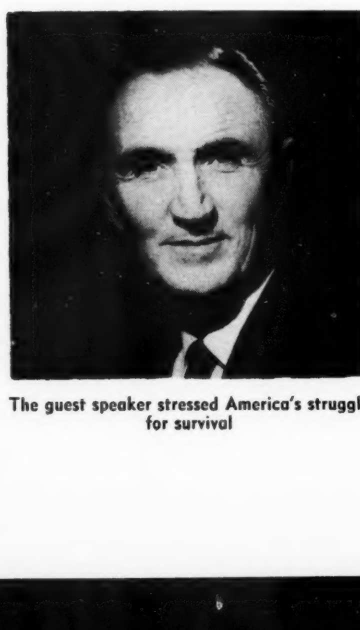
MEMBERS OF THE AMERICAN MINING CONGRESS gathered in New York on December 5 for their 61st annual membership meeting. More than 200 prominent leaders in the coal, metal mining, industrial minerals, and mining equipment industries were present for the dinner meeting and the business session which followed.

AMC President Raymond E. Salvati, who is also President of Island Creek Coal Co., presided over the dinner program and the Directors' meeting. He introduced other AMC officials to present their regular reports.

Andrew Fletcher, Chairman of the AMC Finance Committee, presented his report on the financial status of the Mining Congress, which showed a balanced budget for the year 1960, and a satisfactory cash reserve.

Executive Vice President's Report

Julian Conover, Executive Vice President, reported briefly on the work of the American Mining Congress during 1960. Thanking the industry for its interest and support over the years, he pointed out that "the job is never finished, and there are many problems ahead that will continue to call for our best efforts if the mining industry is to progress and prosper."



The guest speaker stressed America's struggle for survival

After outlining the broad range of Mining Congress activities—including its publications, its technical committees which bring operators and manufacturers together in a joint effort directed towards improving mining techniques and equipment, its work in promoting safety, its conventions and expositions, and its constant activity in keeping the industry posted on developments—he went on to summarize legislation and Government policies affecting the industry.

Conover referred to taxes as "one of the most important activities of the American Mining Congress" and briefly related developments during the past year in percentage depletion and cutoff point legislation. He pledged the Mining Congress to continue its efforts "to obtain more realistic treatment of depreciation, more adequate deductions for exploration, and to maintain the general principle of percentage depletion which is so vital to the mining industry."

In the public lands field, Conover pointed to the "continued pressure behind proposals to set aside vast wilderness areas in which mining and other productive activities would be virtually barred." He cited the mining industry's position of opposing such legislation, and firmly advocating multiple use of the public domain, with adequate opportunity for mineral development. He also discussed attempts—thus far unsuccessful—to restrict the

right of access to mining claims within national forests, but pointed out the need for continued vigilance to preserve the miner's traditional rights.

Other subjects touched upon were progress toward drafting a bill to provide pre-discovery protection for those using modern prospecting techniques, and suggestions for modernizing of State laws relating to location, discovery and assessment work on mining claims.

Conover described efforts made towards formulating national minerals and fuels policies, and discussed the need to maintain safeguards against unwise and disruptive disposal of materials from stockpiles. Restrictions on residual oil imports, a proposed Congressional study of national fuels policies, and creation of the Office of Coal Research were also discussed.

He remarked on several measures that may be classified as "anti-business legislation"—including the proposed pre-merger notification bills, the Kefauver-Patman bills to eliminate the good-faith defense against charges of price discrimination, and measures to require advance notification of price increases in basic industry.

Conover mentioned, but did not have time to discuss in detail, a number of other important items which had required attention during the year. In all matters, he said, the Mining Congress has "tried to serve the industry and to see that its problems are understood and properly dealt with."

Mansfield Stresses High Stakes in Foreign Policy

Addressing the AMC Membership Meeting as guest speaker, Senator Mike Manfield of Montana, Assistant Senate Majority Leader in the 86th Congress, and undoubtedly slated for an even higher position in the 87th Congress, told the miners that he started out many years ago, as a "mucker," having worked in mines at Butte, in the Coeur d'Alenes and in Bisbee. Working in the mines, he said, gave him a chance to study human nature at first hand, and he added that much of what he learned in the mines has been responsible for his philosophy in subsequent years. Mansfield observed that in all segments of the mining industry there are "too many ups and downs" and that "sometimes the downs are all too often most apparent."

Turning to foreign affairs, he pointed out that the mining industry must be cognizant of what is going on in the world and must recognize that difficulties anywhere on the globe have a profound effect on our country and its citizens.

Mansfield discussed the gold problem and the mission headed by the Secretary of the Treasury to try to stem the outflow of gold from this country. He noted that the gold reserve is now below $18 billion, and that practically all of it is callable if the demand is made. This, he said, "doesn't mean that there is any possibility of an immediate devaluation of the American dollar, but it does mean that the American dollar today is not as strong as it has been in past years."

The gold drain, he pointed out, is not caused by an imbalance in foreign trade, but rather by foreign aid spending, which has resulted in a total imbalance and is something that must be met by the Administration. Mansfield hailed Secretary Anderson's recent mission to Germany as a fine effort to "bring home to the European Nations the situation as it really is." He said that it has helped to clear the way to more multilateral assistance and less in the way of unilateral assistance. Some members of the United Nations, he observed, vote very easily and eagerly for new programs calling for tens and hundreds of millions of dollars, but they expect the United States to "pick up the tab." We must be more careful how we handle our funds, he said, and we should "operate on a multilateral basis and in this way bring about a sharing of the responsibilities."

Mansfield went on to talk about important areas of the world, and proposed some changes in our foreign policy. In Western Europe, he said, the Europeans themselves should be made responsible for military and economic strengthening of NATO. As to the Middle East, Mansfield is of the opinion that our work there has been generally ineffective and that we must face up to the basic differences between the Arabs and the Israelis if there is to be peace in that area. He added that we must also accomplish better results from our efforts in Asia.

Japan, he observed, is one of the biggest customers for many American products; also it has insufficient land to produce food for its people—"so," he said, "the Japanese have to trade to live, anywhere, and with any country. . . . Americans have to recognize that the peace of the Pacific is dependent upon two countries, Japan and ourselves. . . . If they can't make a living with the free world, they are going to be forced to trade with China and the Soviet Union, and the next step would be the absorption of the Japanese Empire into that bloc."

Pointing out that Africa has a real problem, stemming largely from a lack of qualified leaders, the Senator expressed his hope that it would be possible to isolate Africa from the cold war. He proposed that a fund be developed through the United Nations, to which the United States would contribute 25 percent; Western Europe, 25 percent; the Soviet Union and its member states, 25 percent, and the rest of the world, 25 percent.

Turning to Latin America, Mansfield discussed the situation in Cuba and other countries. Again he called for more effective action—not on a unilateral basis, but on a multilateral cooperative basis. He advocated a strengthening of the Organization of the American States in an effort to "bring order out of the chaos which exists at present."

In his concluding remarks,

(Continued on page 54)

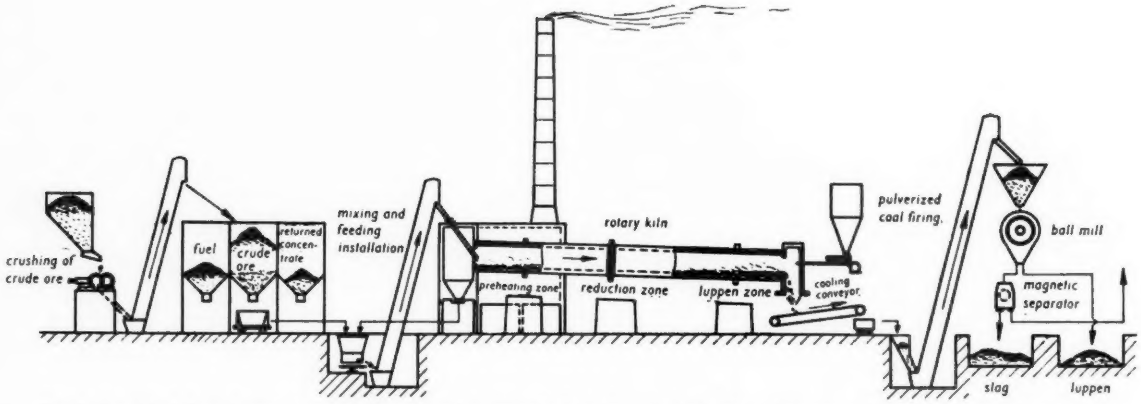


Fig. 1. Simplified flow diagram of a Krupp-Renn plant. Kiln feed, made up principally of iron ore and solid fuels, moves countercurrent to the reducing and heating gases and is discharged from the kiln as luppen-bearing slag

Krupp-Renn Direct Reduction Process

Iron ores that have a wide range of physical characteristics and chemical analyses can be reduced without metallurgical coke by using anthracite fines, coke breeze or carbonized char from high volatile fuels

By MAX J. KENNARD
Vice President
Southwestern Engineering Co.

ANY one metallurgical process is not necessarily the ultimate answer to all ores and conditions, and the Krupp-Renn process is no exception, but it has proven to be adaptable to iron ores over a wide range of physical characteristics and chemical analyses. The iron is reduced by solid fuels into low carbon nodules or "luppen" containing over 92 percent metallic iron for subsequent use in the making of steel.

It is acknowledged that, to a large extent, the Renn process must fit into present steel-making facilities and earn its place in the over-all economic picture. For instance, it is not claimed that the process will necessarily replace present blast furnaces, but it can be used to supplement hot metal production by reducing inexpensive, low-grade, siliceous, iron ores to the metallic luppen for subsequent charging to the blast furnace as part of the total furnace burden with certain economic advantages. This is being done on a large commercial tonnage basis in Germany, and recent large scale tests in the United States have proven the economic feasibility of this approach.

Process Was Developed in 1930's

The Krupp-Renn process was developed in the early 1930's by Krupp metallurgists and by 1945, 38 Krupp-Renn kilns with an aggregate output capacity of one million annual tons of luppen were in operation throughout Europe and Asia. Many of these were removed or destroyed during World War II. In 1950, Krupp again was in the position to design, fabricate and construct Renn kiln installations, and several plants have been commissioned since then including two kilns in Spain, four in Salzgitter-Watenstedt, Germany, and within the past year, six 15-ft by 360-ft kilns in Essen-Borbeck, Germany. The latter plant has an annual capacity of over 500,000 tons of luppen.

A Renn Plant was also built in Japan prior to World War II and has since been reactivated and enlarged to successfully treat low-grade titaniferous iron sands by Kawasaki Steel Corp. near Kuji City. On a recent visit by Southwestern Engineering Co. engineers, data was collected that gave proof of successful operations, together with successful use of the luppen in blast furnaces as a supplemental charge, and also in electric furnaces for steel making.

Luppen, Slag and Middling Separated Magnetically

Figure 1 shows a simplified flow diagram of a typical Renn plant. Ore and solid fuels, the principal components of the kiln charge, are crushed to four to eight mesh, depending on the occurrence of the iron, and are evenly mixed with flue dust, magnetic middling product, and any fluxes that are required. The mixture is fed continuously into the kiln and travels countercurrent to the flow of the reducing and heating gases. The reduction of the iron oxides to sponge iron

takes place at temperatures ranging from 600° to 1100° C (1112° to 2012° F). The last zone of the kiln is known as the luppen zone where the iron sponge welds together to form luppen, which remain distributed in the pasty slag.

This luppen-bearing slag is discharged from the kiln and immediately quenched and cooled by water. It is then crushed and ground in standard crushers and grinding mills and magnetically separated into luppen, slag, and a magnetic middling which is returned to the kiln. The luppen as recovered vary in size from 1 mm to approximately 2 in. with 90 percent being under 3/8 in.

Figure 2 shows the reactions throughout the length of the kiln. With regard to the composition of the slag, the process requires only a pasty slag at temperatures between 1200° and 1300° C (2192° to 2372° F). It must be acid and should be equivalent to approximately 60 - 15 - 25, SiO_2 - Al_2O_3 - CaO. This ratio still permits a fairly wide range of ores in actual operation as slags are always formed by more constituents than the three mentioned.

Efficient use of the latent and sensible heat of the gases is realized. The waste gases will have a temperature of approximately 400° C (752° F) under normal operating conditions and with practically no combustible gases remaining.

Metallurgical Coke Not Required for Reduction of Ores

Generally, the process can treat low grade and siliceous ores, or fines from higher grade ores, that are not economical or desirable as a direct or beneficiated charge to blast furnaces, with the iron content being reduced with reduction material of lower quality than metallurgical coke. This can be coke breeze, anthracite fines, or carbonized char from high volatile fuels.

Ores of very fine physical structure that generally pose problems of separation and beneficiation also are readily amenable to the Renn process. These conditions favor direct reduction but in each instance variables, such as cost and characteristics of ore and reduction material, end use of luppen, capital, and transportation costs, must all be investigated for the purpose of developing a complete economic picture before definite statements can be made as to the desirability of direct reduction.

It has been said in a publication by the U. S. Bureau of Mines that there are at least 27 chemical reactions possible in an iron blast furnace. This same statement can be applied somewhat to any reduction process, which points out the importance of a thorough investigation of ores and reduction materials available for each case where direct reduction is being contemplated, and there is no formula that will fit all instances.

There has been considerable discussion on phosphorus and sulphur insofar as the direct reduction processes are concerned. As a general rule in the Krupp-Renn process, 70 percent of the phosphorus and 30 percent of the sulphur in the charge will report in the luppen. However, these figures do not always hold, and in some instances, the luppen have contained only 0.05 sulphur when the "rule of thumb" indicates that 0.3 to 0.5 should have reported. This difference can be attributed to the type of fluxes used and the chemical analyses of the ores treated. It was definitely proven in the demonstration run mentioned herein that the sulphur content could be held to less than 0.05 when using a reduction material containing nearly one percent sulphur.

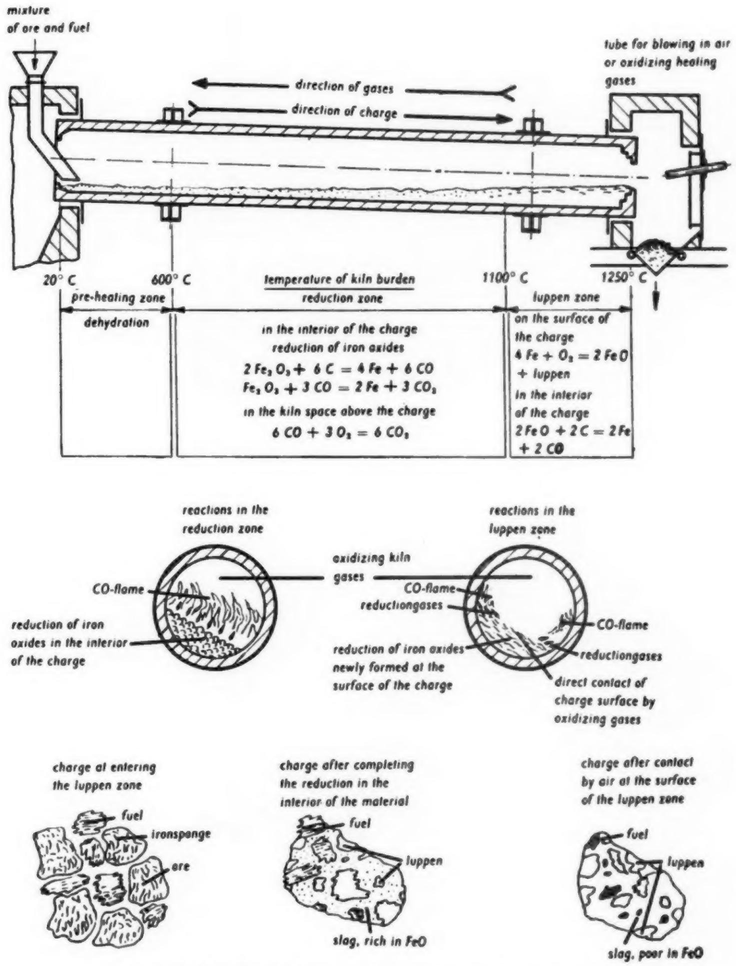


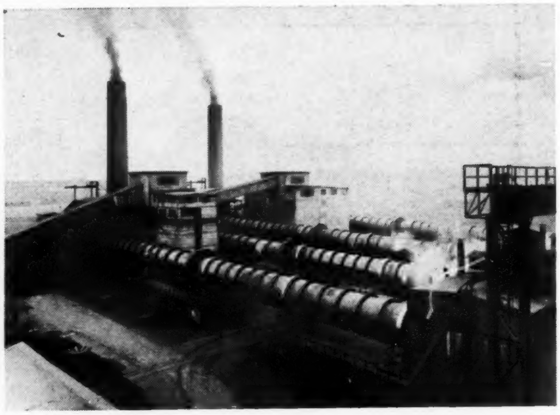
Fig. 2. Metallurgical reactions in the Krupp-Renn process

Plant Simplicity Noteworthy Feature

A demonstration plant was operated in the United States in 1959 by Southwestern Engineering with the technical assistance of Krupp personnel. During this time approximately 12,000 tons of finely disseminated titaniferous iron ore averaging 47 percent Fe and 18 percent TiO_2 were treated and approximately 5000 tons of luppen products were produced, having an iron content of 92 percent plus with less than 1.0 percent TiO_2.

The demonstration kiln was 9 ft by 175 ft in length and facilities were provided whereby the small plant was a close duplicate of a large commercial installation. Numerous representatives from the steel industry

Six 15-ft by 360-ft diam kilns at a Renn plant in Essen-Borbeck, Germany, have a combined production capacity of 500,000 tons of luppen per year



View of Renn plant at Salzgitter-Watenstadt, Germany

throughout the country visited this demonstration plant and the simplicity of the operation was noted and commented upon.

Basic data of the Krupp-Renn process is as follows:

1. Grade of iron ore amenable to treatment —30 percent Fe to 50 percent Fe, with an optimum grade of approximately 42 percent. Ore with TiO_2 content up to 20 percent has been successfully treated. SiO_2 content up to 35 percent under proper conditions is acceptable. Resulting slag to be approximately 60 percent SiO_2.
2. Metal to slag ratio approximately one part metal to a range of 0.8 to 1.2 parts of slag.
3. Iron recovery is from 90 percent to 94 percent.
4. Capacity of kilns is approximately 0.7 ton of charge per cu meter of kiln volume. This includes fluxes but is exclusive of recycle and reduction materials.
5. Size of feed is preferably minus four to eight mesh with a minimum of fines; however, no difficulties have been encountered with feeds containing up to 20 percent minus 200 mesh.
6. Dust loads have been found to be very low with proper plant design and amounting to as low as two percent when using the above typical size feeding.
7. A large percentage of the total heat requirement is furnished from additional reduction fuel above that needed for reduction. The remaining portion is furnished by burning either fuel oil or pulverized coal in standard burners in the discharge end of the kiln. Fixed carbon requirements for the kiln charge vary with type of fuel. When using coke breeze containing approximately 80 percent fixed carbon, a total of 700 to 800 kg (1540 to 1760 lb) of breeze per metric ton (2205 lb) of luppen is used, depending on grade of ore and slag constituents. For more active fuels such as anthracite coal or lignite char, this will be slightly higher.
8. Direct operating costs exclusive of capital charges, raw materials, taxes, and insurance will vary between $6 and $12 per ton of luppen, depending upon size of plant installed and local conditions. The total cost of luppen is then dependent upon the cost of raw materials and capital charge policy in each particular case.
9. Capital investments costs have been developed from data obtained from recently constructed plants in Germany and adjusted for American plant cost and design criteria. These costs, depending upon capacity of plant and magnitude of handling facilities required, will vary from $45 to $50 per ton of annual capacity without the necessity of capital investment for coking facilities. Again, this phase requires that a design criteria be established for each case. A plant receiving pre-crushed and rather constant grade ore will cost much less than one where crushing, drying and blending facilities are required.

Use of Luppen in Electric Steel Making

While European and Asiatic countries have used luppen for many years, its use in the production of iron and steel in this country has been limited to test runs from the luppen made by Southwestern Engineering in the demonstration operation referred to previously. The luppen produced from the low-grade (less than 50 percent Fe content), finely disseminated titaniferous ore had the following analysis:

Material	*Percentage*
Fe	92. –95.
TiO_2	0.8 – 1.2
SiO_2	0.7 – 1.2
Al_2O_3	1. – 1.5
Carbon	0.9 – 1.5
Sulphur	0.04– 0.07

The metal itself is practically pure iron and carbon, with the other constituents occurring in the slag still adhering to the surface of the luppen. If warranted, further cleaning will reduce these slag constituents.

This metal was charged in an amount in excess of 40 percent of the total charge into a 100-ton electric furnace; and 1500 tons of luppen were thus treated. It was necessary to melt a hot pool from scrap before charging the cold luppen.

The amount of coke and stone used to produce mild steel was reduced when using luppen, and the melt time was equivalent to or less than when using 100 percent cold scrap charges. Additional advantages were noted in the minimum and constant content of residuals.

Conventional handling methods employed in a standard melt shop were used during these tests, however, it was evident that if a shop were designed to use luppen in the charge, the handling cost could be reduced by using conveyor and hopper-charging methods. Additional savings could be effected and quantities of luppen in excess of 60 percent of the charge could be used if the metal was allowed to flow from the hoppers and directed through the roof of the furnace to the arc of the electrodes at a controlled rate. The test run was successful and proved that luppen could be used economically as a source of iron in electric steel making.

Performance of Luppen in Blast Furnace Practice

As stated previously, luppen have been used in Germany as blast furnace feed on a commercial basis for many years. The findings of the Germans were confirmed in our own investiga-

tions, whereby up to eight percent of the total iron charged to a blast furnace as luppen reported as hot metal without the use of additional coke and with negligible dust loss even when using minus 16 plus 48 mesh magnetic fines.

If a greater amount of luppen were to be used, some additional coke would be required to effect the melting, but the quantity is far below that required to melt the ore and reduce the iron in a conventional manner. This information was developed from using approximately 1500 tons of luppen as part of blast furnace charges in an integrated steel plant in the U. S.

In Europe the hot blast cupola is a common hot metal producer in the steel industry, while in the U. S. this type of furnace, working from a pig iron, scrap, coke, and flux charge, was used in the past basically as a source of hot metal for foundries. In the last few years, however, steel is being produced by American steel manufacturers using the hot blast cupola in conjunction with oxygen blowing. As in Europe, up to one-third of the metallic thus charged could consist of luppen.

Advantages of Process Outlined

In summary, low grade, siliceous, or finely disseminated iron ores not desirable for blast furnace feed can be reduced at low cost into 92 to 95 percent metallic nodules when using cheap, fine-grained fuel, without the use of beneficiation and pelletization of the ore.

Recoveries of up to 97 percent can also be attained when using unroasted and unsintered fines from higher grade ores, giving metallic luppen which are practically free from slag. Luppen thus produced can be added to the blast furnace burden or used as melting stock in electric arc cupolas or open hearth furnaces for direct conversion into steel.

Requiring no metallurgical coke, the process enables the economic production of iron using cheap, fine-grained, high-ash reductants and fuels. Countries having no coking coal are therefore in a position to establish an iron-producing industry on the basis of indigenous deposits of non-coking coal. It is especially in these cases that the Renn process enables high-grade coarse or fine-grained ores to be treated to an advantage.

In the production of iron from siliceous and finely disseminated ores, the process offers the advantages that the gangue is completely separated, iron is produced in compact metallic form, over-all iron recovery is higher than when the known methods of simple beneficiation are used, and recoveries are believed to be equal to any direct smelting operation.

In the Renn process, similar to blast furnace operations as practiced, complete desulphurization is not a limiting factor due to the modern use of oxygen in steel production.

MAINTENANCE OF STRIP MINE ROLLING STOCK

(Continued from page 31)

pressure switch. It is necessary to hold this switch closed until oil pressure builds up. When the pressure is up to normal, this switch can be released and the oil pressure switch in the engine oil system automatically takes over. If for any reason lube oil pressure drops below 15 lb, the oil pressure switch automatically causes the solenoid valve in the fuel line to shut off the fuel, stopping the engine and preventing damage to bearings, rings and liners. Truax-Traer's newer truck engines are factory-equipped with such safety switches.

The company does something else which might benefit many mines. It has a roving trouble-shooting mechanic who can quickly get to any part of the mine to make minor repairs or adjustments. He has a radio-equipped panel truck outfitted with a supply of frequently needed parts and necessary tools. This truck rolls up about 12,000 miles a year, mostly within the mine area. All parts of the mine are linked by radio, with radios installed in the pickup trucks of the master mechanic, chief electrician and pit foremen, as well as on the shovels, draglines, wheel excavator, warehouse and office.

Truax-Traer also has what it calls a "bull gang" for heavier jobs. These men work with a five-ton truck equipped with a double-drum winch and rear-mounted boom, and they perform a variety of jobs—repair, installation, and utility. The truck carries a cutting torch . . . it can tow a welding unit . . . and it is busy all the time.

Other devices include company-built special ladders to make servicing and repair easier in the shops, and special flaps to keep mud off door closing rewinds. Also, to help pull machines from soft areas, pull chains have been installed on the tracks.

Also falling into this classification is a spare parts pool formed by the strip mines in the area. Each operator stocks certain large shovel parts such as d-c armatures, generator armatures, various coils, gears, pinions and shaft. When one mine needs a part not in its own stock, it borrows from the mine stocking the item. In this way, all operators are protected with a minimum cash outlay.

The Open Pit Mining Association Electric Division, with help from the electrical manufacturers, shovel manufacturers and operators, has compiled a list of all electric shovels and dragline parts which are interchangeable. This list shows which mine has spares and whom to contact.

Response to these emergencies . . . even if you call someone from bed at 3 A.M. . . . is wonderful. Parts are normally on their way to the down machine within two hours.

Maintenance Is Everyone's Business

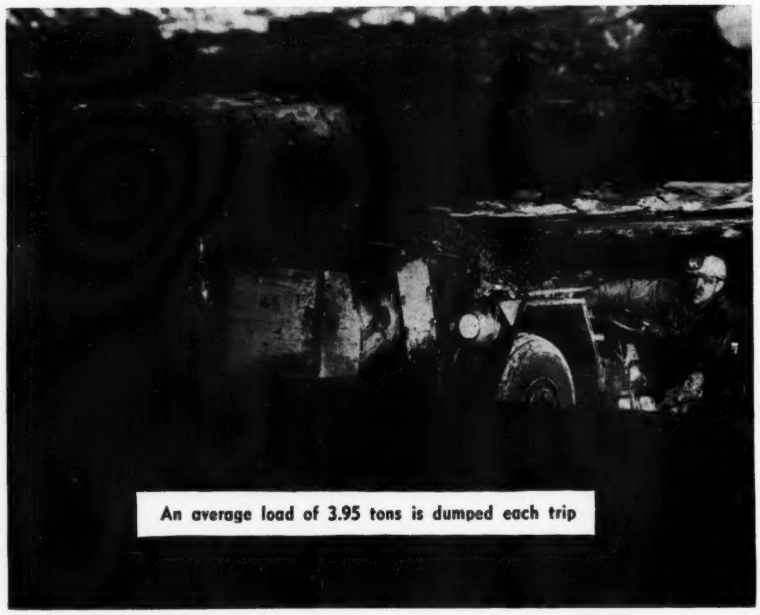
Often with preventive maintenance, the problem is finding the opportune time, not determining the proper procedure. Machines are bought to produce, not to be maintained. Understandably, some production supervisors resist taking a machine from production for routine servicing.

The point is: any maintenance program is lost without complete cooperation of supervisors, mechanics and operators. Supervisors must influence operators and mechanics in such a way as to make them maintenance minded.

At one of Truax-Traer's mines, the garage foreman sees each haul truck dump its first trip every morning. He checks, among other things, oil pressure, tires, and radiators. The second shift mechanic makes a point of seeing each unit dump its last load—checking with the driver to be sure everything is in order. If not, he will know what needs to be done and the necessary repair or adjustment can be taken care of that night.

By keeping their eyes and ears open, operators and oilers at Truax-Traer have often prevented serious breakdowns. Unusual noises are often warnings of approaching trouble. On several occasions shovel crews have found cracks that if allowed to continue would have developed into major repairs and sometimes disastrous breakdowns.

The lesson here is clear: Maintenance of strip mine rolling stock is *everyone's* business . . . and it is a cost saver, a necessary part of any profitable stripping operation.



An average load of 3.95 tons is dumped each trip

SHUTTLE CAR HAULAGE at LANCASHIRE NO. 15

Six-wheel, thin-seam shuttle cars have proved themselves at a Pennsylvania coal mine

By JOHN S. TODHUNTER
General Manager
Barnes & Tucker Co.

FOR over 18 years shuttle cars have been one of the major transportation links in the Lancashire No. 15 mine of Barnes & Tucker Co. Storage batteries motivated the first cars used in 1941 and 1942, and they provided the experience and knowledge leading to the selection of four-wheel drive, cable-reel cars of the Lee Norse variety in 1942. The design of the first Lee Norse car is fundamentally that used in most shuttle cars hauling bituminous coal since the early forties. However, time has taken its toll and this early model has become obsolete due to the many improvements in later cars, along with increasing cost requirements, calling for higher capacities and more speed with less down time. Observations, trial and study of various shuttle cars led to the selection of the recently developed Joy 18 SC.

6000 TPD Mine Uses Ten Continuous Mining Machines

The 6000 tpd of coal mined in Lancashire No. 15 are first transported from the face by twelve 18 SC Joy shuttle cars, four 66A Jeffrey shuttle cars and one 30 d-c National Mine Service Co. Torkar. Loading the shuttle cars are four 76A Jeffrey Colmols, three 76 AM Jeffrey Colmols, three 3JCM Joy continuous miners, and one 14 BU Joy loader. A single 14 BU Joy loader plus one shuttle car are used behind each of the 3 JCM miners. The remaining units are served by two shuttle cars each. In production entries, shuttle cars dump directly onto 36-in. belt conveyors which in turn discharge into eight-ton capacity steel mine cars. Locomotives transfer the cars to a main side track where rope haulage takes over to the outside. The locomotive haul averages about 12,000 ft and the rope haul is 12,500 ft. Thirty-car trips arrive outside every half hour. Bottom is taken for track haulage on the main development entries where shuttle cars dump directly into mine cars.

Coal height averages 42 in. in No. 15 and varies from 39 to 46 in. Called the Lower Kittanning or "B" seam, it is uniform with a top bone of two to eight in. which is being left. Above this is normally a strong black shale roof varying locally to broken cross-bedded sandstone. Below the coal seam is four to six in. of fireclay underlain by two 6–12 in. coal plies which are separated by another layer of fireclay six to ten in. thick.

Mains consisting of five entries each are driven into the mine, and three-entry production butts are advanced at right-angles on both sides of the mains. All entries are on 60-ft centers with crosscuts staggered on 80-ft centers. Rooms are driven on 45-ft centers off the butts and are worked on the outby side of the butt advancing with pillar extraction carried simultaneously. Upon reaching the normal limit of 1500 ft, retreat begins with room and pillar work starting on the inby side and heading stumps are removed as room work finishes. This mining system has been used in No. 15 since the introduction of belt conveyors in 1931, and has been used successfully with hand-loading on conveyors, conventional loading machine units and continuous mining with shuttle cars.

Features Looked for in Selecting New Shuttle Cars

With the step-up in productivity through continuous mining, and

higher capacity through 36-in. belts and improved track haulage, the company's obsolete shuttle cars failed to stand up mechanically and capacity-wise. Excessive wheel unit failure was dominant and maintenance cost was, stating conservatively ten times greater than recent models of similar cars. Since, in recent years, it was observed that practically all shuttle cars produced had attained maintenance costs negligible in character, it was decided to concentrate on those features tending to increase the time available under the mining machines. The following were looked for:

1. **Highest capacity**
2. **Greatest possible speed**
3. **Best maneuverability**
4. **Most practical dimensions**
5. **Easiest receiving end**
6. **Fastest discharge**
7. **Most operator comfort**
8. **Ease of maintenance**

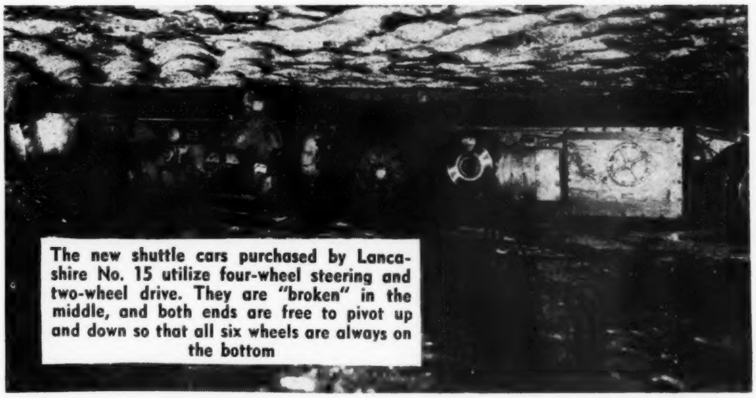
A good look was taken at all of the available four-wheel drive cars and decisive conclusions reached regarding them, but the six-wheel 18 SC was ignored through most of the observations. Having reached the point of selecting a four-wheel drive car, it was decided to take one more look, and the 18 SC at that time was found to be somewhat more appealing. However, if many of the unorthodox features presented served the purposes for which they were made, proof had to be established. Specifications were set for two trial cars, and in May 1959 they were put into service.

To briefly describe the Joy 18 SC shuttle car, it has six wheels— the two on each end doing the steering and the two wheels in the center doing the driving. The car is "broken" in the middle and both ends pivot across the driving section. Each side is chain-driven and no wheel units are required. A later listing of final specifications detail clearly the construction and operating features.

Trial Cars Exceed Expectations

Since maximum values of all the features desired in a new shuttle car were the objectives, the trial car specifications were stretched as far as considered reasonably possible, and the following resulted:

1. Height—32 in.
2. 10:00 by 15 driving tires with alternate 8:25 by 15 for lower height
3. Reel for 450 ft or more of cable
4. Maximum width—110 in.
5. Length—27 ft 6 in.
6. Discharge to be fixed but capable of unloading from a ramp over an 18-in. high belt
7. Operating positions to be standard
8. Conveyor to discharge in 45 seconds, meeting belt capacity
9. Operating seats as low as possible
10. Reversing conveyor
11. Capable of hauling on grades up to 19 percent. Hydraulic boosters for concentrating load on the drive wheels to be installed
12. Speed—4 to 5 mph
13. Capacity—6 tons through a 56-in. wide conveyor
14. Receiving end to be sloped to best accommodate the Colmol discharge
15. 15-hp traction motors to be installed
16. Inside of the conveyor to have straight sides



The new shuttle cars purchased by Lancashire No. 15 utilize four-wheel steering and two-wheel drive. They are "broken" in the middle, and both ends are free to pivot up and down so that all six wheels are always on the bottom

During the trial, the wide first conveyor of the Colmol was extended to attempt heavier loading of the 18 SC. Although improvement was noted on straight runs, too much difficulty was experienced in turns, and the change was abandoned. Consideration was given to attempting automatic oscillation of the Colmol conveyor, but this idea was also given up.

The trial cars worked far better than was expected, even with the exaggerated features. The following were found improper, and specification changes were made to correct them in any new cars:

1. The car was too long and wide to work with the most practical timbering standards and entry dimensions.
2. Rigid discharge was found undesirable and an elevating boom was specified.
3. The conveyor was too wide and could not be loaded full in the available operating height.

The following were established and accepted as part of any new cars:

1. The two-wheel drive units successfully negotiated all grades and, although the cars could be stuck in bad bottom conditions, they did as well in this respect as any four-wheel drive in similar conditions. The hydraulic boosters required little use.
2. The position of the operator between the wheels created a greater feeling of safety and provided less jarring and shaking than that of cars locating the operator on the ends outside the wheels.
3. The hinged center followed bottom contours more easily, with a concen-

(*Continued on page 42*)

The 32-in. high cars are equipped with an adjustable traction device to improve tractive effort where desired by adding weight to the driving wheels

By BERNARD W. CAREY
Assistant Superintendent
Cary Mine
Pickands Mather & Co.

Fighting Underground Mine Fires with Foam Producing Detergents . . .

a secondary method of attack that can provide control of fires where direct attack is not effective

ONE of the most interesting new developments in fighting underground mine fires is the high expansion foam plug technique. This was developed by the British and reported on in the summer of 1956 at the 9th International Conference of Directors of Safety in Mines Research. Our own U. S. Bureau of Mines took up the investigation in 1957 and has since demonstrated the practicability of using this technique in American coal mines. Pickands Mather & Co. first became interested in this subject when the Bureau published its report of investigation in the fall of 1958.

Foam Plug Technique Explained

The foam plug technique consists simply of filling a mine entry or tunnel tight to the back with soap bubbles. These bubbles, being very lightweight, are moved along in a continuous plug to the fire area by the mine ventilating air currents. When the foam reaches the fire area, and providing it contains the proper amount of moisture, it tends to quench the fire in four ways:

(1) **It reduces the volume of air feeding the flames and thereby partially smothers the fire**
(2) **The foam cools the fire area by evaporation of the contained moisture**
(3) **It dilutes the oxygen by formation of water vapor**
(4) **It serves as a radiation shield**

In most of the fire tests conducted by the Bureau of Mines, it was found that the foam would not completely extinguish a fire but would effectively control it. By their definition, this meant quenching of the flames and reduction of the temperature to a point where the fire could be fought directly and without protective clothing.

An idea of the conditions under which the foam plug has been tested, is obtained from an experiment conducted in the Bureau's experimental coal mine at Brucetown, Pa. A coal bed 100 ft long, 5 ft wide, and containing over 24,000 lb of coal was ignited and allowed to burn for five hours. By this time a temperature of 1490° was obtained. Generation of foam was then started from a point 350 ft upwind of the fire. In 30 minutes from the time the foam first hit the fire area, the temperature was reduced to 890° and the flames quenched so that fire fighters were able to approach the fire area and play water on remaining coals.

In 15 separate fire tests conducted by the Bureau, foam plugs successfully controlled the fires in 12 instances. The successful foams all contained five cc (0.2 oz) of water per cubic foot of foam. Foams which contained less than five cc of moisture retarded the fires but did not control them.

The amount of moisture contained in the foam is controlled primarily by the type of detergent used. Factors such as water temperature and hardness and strength of solution also affect the liquid content of the foam.

Efforts to produce foam plugs were begun at the Cary mine in the summer of 1959, and since that time about 20 separate experiments have been conducted with varying degrees of success. All have been on a small scale with no financial outlay except for the price of the detergent. In general, we are now well satisfied with our ability to produce foam plugs, however, in retrospect, it seems that we made about every mistake in the book.

Dilute Detergent Solution Sprayed on Net

The process by which the foam is produced is very simple. A dilute solution of detergent is sprayed on a coarse cotton net stretched tight across the mine entry. If the net is kept saturated with the solution while the mine ventilating current flows thru it, foam in the form of bubbles ½ in. to 1½ in. in diameter are very rapidly formed on the downwind side. These bubbles honeycomb and

Travel through foam without apparatus is not recommended, but in a fire it could provide a cool, safe emergency exit

quickly form a plug which fills the entire cross-section of the entry and continues to grow in length as long as air is forced through the saturated net.

There are only three important variables to be controlled in producing foam:

(1) **the amount of solution flowing on the net,**
(2) **the amount of air flowing through the net,**
(3) **the strength of the solution—that is, the ratio of detergent to water.**

If these three items can be controlled within the specified limits, there should be no difficulty in forming foam plugs. One qualifying exception to this would be for those mines which have excessively hard water. Successful foams have been formed using untreated water with hardnesses up to 500 ppm. Water softening has been effective on water between 500 and 10,000 ppm hardness, but this seems to be the practical limits with presently used detergents.

Downwind side of the net as spray is first started. As long as the net is kept saturated with solution while the mine ventilating current flows through it, bubbles ½ in. to 1½ in. in diameter are formed rapidly and honeycomb to fill the entire cross-section of the entry

Of the three variables mentioned, the amount of solution on the net would probably be the easiest to control. The proper amount is a function of the cross-sectional area of the net and the air velocity through it. It is very important that the net be completely saturated throughout the foam generating period, and the best way to insure this is to provide an excess of solution. For nets 30 to 60 sq ft in area and with air velocities of 150 to 300 fpm, water volumes in the order of 50 to 75 gpm are required at sufficient pressures to give a good spray. If a mine can supply a sustained 100 gpm at nozzle pressures of 50 psi., they probably have enough capacity for all practical purposes.

Maximum Length Plugs Produced with High Air Pressure

Control of the second variable—the amount of air through the net—poses more of an individual problem. While the Bureau of Mines has created foam plugs in air velocities ranging from 80 fpm to 600 fpm, the most successful results were obtained at velocities between 100 and 200 fpm. In metal mines these velocities are easily obtained simply by regulating air splits, and if necessary, to obtain the desired amount of air pressure, the bulk of the mine's entire ventilation can be diverted through the net. In coal mines, where explosive atmospheres sometimes occur, such a plan is often not feasible.

A more practical approach would seem to be a portable, self-contained unit consisting of an adjustable high pressure blower fan connected through a flexible duct to the netting frame. Incorporated in this flexible ductwork would be a preadjusted spray focused on the net. Such a device was constructed and tested by the Bureau with good results.

The practicability and availability of such a unit would be advantageous even for most metal mines for at least two reasons. First would be the time saved in starting to generate foam, which in fire fighting, is often a critical consideration. Second, a high pressure fan capable of producing up to ten in. of water gauge would have power enough to develop maximum length plugs.

The length that a foam plug can be developed is primarily dependent upon the available air pressure, the coefficient of friction of the mine walls, and the viscosity of the foam. To give an idea of the air pressure necessary, the Bureau used 2.0 to 2.2 in. of water gauge to drive a rela-

Checking foam plug for tightness as it advances through a timbered drift

tively moist plug 1000 ft. They required 4.5 to 5.0 in. to extend the plug to 1500 ft. To the writer's knowledge the longest plug produced by the Bureau was about 1600 ft long.

The last of the three variables—the strength of the solution—is also an individual problem since the correct amount of detergent is determined by the hardness of the available water. For waters under 200 ppm. hardness, a satisfactory detergent strength will approximate one percent by weight. Each property should experiment to find the exact ratio that best suits the conditions.

Factors Affecting Choice of Mixing Equipment

There are several different schemes for achieving the desired proportions incuding chemical pumps, proportioners or eductors, which operate on a syphoning principal when motivated by the main water stream; and putting the detergent tanks under pressure to force the detergent into the water stream. Each has advantages and disadvantages, but the best choice can only be made by studying conditions of the individual mine. Some of these conditions would include the mine water distribution system and variances in pressures and volumes, ease with which bulky material can be transported throughout the mine, and availability of electric power or compressed air. Regardless of which proportioning method is used, flow gauges or meters should be employed to assure positive control of the final mix.

A cotton, open-mesh net stretched tight across the entry, an ample amount of a suitable solution sprayed in such a manner that the entire net is kept well saturated, while the proper amount of air is forced through it—these things are about all that operating personnel have to know about generating foam plugs. However, it would be foolhardy to put off training crews in the use of foam plugs until the fire starts. There are tricks to all trades, there are individual problems and conditions which must be identified and compensated for. If the foam plug technique is to be utilized to its fullest potential, then mine rescue crews must be given ample and periodic training in its use.

Application of Foam Plug Technique

The foam plug technique should not be considered a primary fire fighting method. Ordinarily the best way to fight a fire is by direct attack with water or chemical extinguishers, but, for one reason or another, this may not be possible.

Perhaps, as often happens, a roof fall in the initial area of the fire obstructs the fire fighters' access while the flames continue to advance on the downwind side. Explosive hazards from dynamite or gases might make direct attack impossible. Shaft or raise fires, not uncommon in metal mines, are very difficult to fight directly. These are the types of fires for which the foam plug operation holds the most promise of success—fires which have heretofore generally resulted in bulkheading the area and extinguishing the flames by exhausting the oxygen. This is invariably a drawn out and costly procedure, and in badly fractured ground, it is often a hopeless one.

The foam plug technique is not intended to solve the problem of deep-seated, wide spread fires which have raged out of control for many hours or even days. Here again only bulkheading or the even more drastic solution of flooding or sand filling will successfully put out the fire.

It is intended to be a secondary fire fighting method by which major fires can be averted if the foam is properly and quickly applied as soon as it is determined that direct attack is not effective. This statement is substantiated by the many successful fire tests of both the U. S. Bureau of Mines and the British Safety in Mines Research Establishment. These organizations merit the commendation of the mining industry for developing this new defense against underground fires, but their efforts are largely wasted unless the industry now assumes the initiative to put the development to practical use. This can only be done by those organizations with foresight enough to study the new technique and familiarize themselves with its applications and problems.

SHUTTLE CAR HAULAGE

(*Continued from page 39*)

tration of load over three sets of wheels absorbing shock extremely well, resulting in increased operator comfort.

4. The wider turning radius proved better than that of the shorter radius four-wheel car because a longer, more gentle arc was negotiated by the steering wheels and the actual clearance radius was not affected noticeably.
5. Reduction of mechanical and electrical failures from shock and jarring is anticipated.
6. Higher speeds are possible over rougher conditions because of eased jarring and improved maneuverability.

Final Specifications Include Four-Wheel Steering, Two-Wheel Drive

After six months of trial, the final specifications of the car were established and the 12 cars purchased were built as follows:

1. Four-wheel steering and two-wheel positive drive (six wheels, no differential).
2. Pneumatic tires, 10:00 by 15 on drive wheels and 9:00 by 10 on steering wheels.
3. Two 15-hp 40J6 traction motors (series wound). Two-speed traction drive with series-parallel control.
4. One 10-hp, 40J4 conveyor motor (series wound).
5. One 10-hp, 40J4 pump motor (compound wound).
6. A 48-in. wide conveyor, adjustable discharge, reversing. Heavy duty chain and flights. No load chain speed, 95 fpm.
7. Heavy duty chain and sprockets on traction drive.
8. Over-all size—32 in. high, 7 ft 11 in. wide, 26 ft 6 in. long.
   Approximate minimum outside turning radius—22 ft 7 in.
   Approximate minimum inside turning radius—11 ft 6 in.
   Ground clearance—7½ in. front, 6½ in. in rear (adjustable to two in. less).
9. Level capacity, 130 cu. ft. Maximum payload, 7 tons. With 4-in sideboards, 165 cu ft—with no hopper slope.
10. Equalized hydraulic steering.
11. Front and rear ends of car pivot near middle of car.
12. Weight—approximately 22,500 lb.
13. Hydraulic disc brake on each traction reducer.
14. Approximate tramming speeds in miles per hour:
    Loaded, level—4.5
    Loaded, 12 percent grade—2.7
    Empty, level—5.1
    Empty, 12 percent grade—3.1
15. Over-all traction drive reduction—39.0:1.
16. Optional sideboards.
17. Conventional cable reel and sheave bracket arrangement.
18. One-piece unit frame and body side construction.
19. Adjustable traction increaser—improves tractive effort where desired by adding weight to driving wheels.
20. A 425-ft, No. 4, 2-cond. flat par. cable with ground.
21. Ventilated controller and swingout panel.

The new cars proved that the improperly exaggerated features first established were corrected. Smooth operation has resulted and an average load of 3.95 tons is dumped each trip. Although the 18 SC cars have only been in service since January 1960, the resulting improvements in cost and tonnage have been gratifying. Further improvements are not unlikely through extended utilization of the increased potential provided. Although the design of the 18 SC may appear unorthodox, it has proved itself remarkably well in the conditions offered by Lancashire No. 15 mine.

Underground Planning and Control Using Electronic Computers

By W. L. ZELLER
Assistant District Industrial Engineer
Frick District, U. S. Steel Corp.

The result of a series of method changes on an underground mining section was a production gain of 528 tpd. By using an electronic computer, only two hours of an engineer's time was required to prove this. Conventional means would have taken countless hours

MODERN computer programing techniques make electronic computers a practical and powerful new tool for production planning and cost control in the coal mining industry.

High speed digital computers are nothing more than elaborate and extremely fast adding machines which can also compare, select, and store numbers. Through either positive or negative addition, the computer can add, subtract, multiply or divide. It can solve any problem that can be expressed by numbers and equations.

Computers are not giant brains, as they are not capable of creative thought. They are more like computing servants which can do no more than just what they have been told to do. Their value, then, lies not only in the ability to unravel heterogeneous information and thus solve problems, but more so in the incredibly fast speeds at which they perform computations.

Before data is fed into a computer, a detailed and complete set of instructions must be introduced which tell the machine exactly what must be done with each number. The format of the data, each required computation and the form in which the answers are desired must be precisely defined. These instructions are called a "program." Expressing the steps required to solve a problem in terms which the computer can interpret is called "programing."

Fortransit Is a System of Programing Used by U. S. Steel

One system of programing, which is in common use in the U. S. Steel Corp. is named Fortransit. This system is used on the IBM 650 computer, although with only slight variation it can be used to write programs for several types of computers, both large and small, which are produced by IBM.

Fortransit is an ideal system of programing engineering and operational type problems because it closely resembles the conventional means of writing equations. Figure 1 shows how several equations would appear in a Fortransit program.

In the first three equations, the only differences between the conventional mathematic equations and the Fortransit statements are the symbols for dividing and multiplying. In the fourth equation, besides using an asterisk for multiplying and a slash for dividing, a double asterisk is used for a root or power and parentheses are used to indicate the sequence of the computation.

These Fortransit statements are punched on cards exactly as they are shown in figure 1 and they are ready to be read into the computer by a card reading machine.

If the computer were to perform the operation $A = B + C$, it would either read the value of B and C from a data card or would obtain the values from two storage locations in its memory which it had previously identified as locations B and C. It would then make the addition and store the value of A in another memory location which it would identify as A. The value of A could then be used later in the program or could be punched on a card. The programmer does not have to know where the values of A, B and C are stored, as the computer does this automatically.

MATHEMATICAL NOTATION	FORTRANSIT NOTATION
1. $A = B + C$	1. A = B + C
2. $RATE = \frac{TONS}{TIME}$	2. RATE = TONS / TIME
3. $TONS = HT \times WIDTH \times DEPTH \times .041$	3. TONS = HT • WIDTH • DEPTH • .041
4. $X = \frac{-B + \sqrt{B^2 - 4AC}}{2A}$	4. X=(-B+(B••2-4•A•C)••0.5)/(2•A)

Fig. 1. Fortransit programing. Note the use of an asterisk for multiplying, a slash for dividing and a double asterisk for a root or power. Parentheses are used to indicate the sequence of the computer

Mining of Coal Simulated on Computer

In the Coal Division of U. S. Steel Corp., a considerable number of programs have been written using Fortransit and many more are planned for the future. One computer program, which has been used many times since it was first completed last summer, is a simulation of continuous mining with a milling type miner. This program is a practical application of electronic computers to a problem in underground mining. It is an extremely useful and valuable pro-

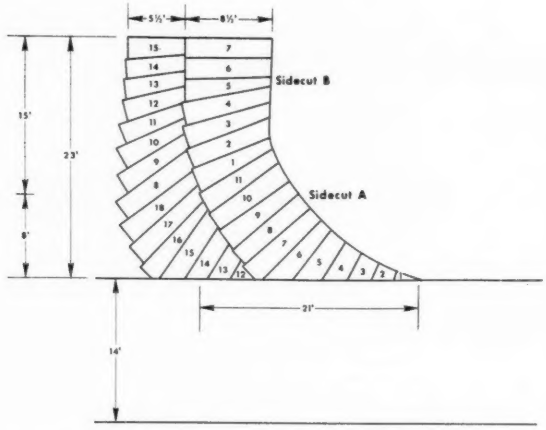


Fig. 2. Individual sumps in a sidecut. The width and depth of each individual pass of the continuous mining machine can be different, both in the time required to perform and in the tons produced. Therefore, the computer program begins by simulating mathematically the basic mining motions of sump, rip and maneuver head

gram because with it, different equipment, mining plans, or working methods can be swiftly evaluated, the effect of natural conditions can be determined, and it will compute accurate production standards, which are essential for an effective cost control system.

The program is broken into two parts and requires two passes on an IBM 650 to obtain answers. The first pass calculates the workloads and running time of the continuous miner and shuttle cars in all conceivable conditions. The output, or answers, from this pass can then be used to determine shift production under any combination of conditions in the second computer pass. The program was broken into two parts to save computer running time. This is possible because the output from the first pass is semipermanent in nature and can be used many times to set standards so long as the mining plan, equipment combination, and crew size do not change.

The input data of the first program includes elemental standard times, information concerning the mining plan, and other types of basic data. The *width and depth* of each individual pass of the continuous miner can be different (see figure 2), both in the time required to perform and in the tons produced. Therefore, the computer program begins by simulating mathematically the basic mining motions of sump, rip and maneuver head. Figure 3 is a flow diagram of this portion of the program which outlines the various branches, or decisions, required. The mining time of each shuttle car is computed and stored in memory for use later in determining the effect of transportation on the mining cycle time. Work performed by the miner operator other than "mine" is identified and either included in the loading time of the proper shuttle car, or is stored for use later in determining its effect on shuttle car change time.

Figure 4 shows the haulage portion of the program which simulates the mining of one cut of coal, and again, only the major branches and loops are shown. In Parts A, B and C the data is brought into the computer. Part D is the portion which calculates the shuttle car loading time and the tons mined. In Part E the computer determines the effect of the shuttle cars traveling to the discharge point, dumping, and returning to the miner. The inter-relationship between two shuttle cars necessarily makes this portion of the program a bit complicated. Before leaving this portion of the program, the computer calculates the cycle times for both a one shuttle car operation as well as for a two shuttle car operation.

After the computer has finished Part E, it has completed one mining cycle of a particular cut type, such as a straight cut or side cut, in one mining height and under one set of conditions.

Sequence in Which Computer "Mines" Coal

To establish a correct production figure, the computer simulates the mining of coal until the relationships of haul distances and cut sequence are ready to repeat. In other words, if the shuttle car discharge points advance after a two-block advance of a section, all the coal mined in the two-block advance is considered by the computer. The four sketches in figure 5 illustrate the sequence in which the computer "mines" coal. If the computer calculates the time and tons of a straight cut in No. 1 Entry first, it will calculate the time and tons of all the straight cuts in No. 1 Entry before moving to No. 2 Entry. All of the straight cuts in the mining plan are calculated under all combinations of height and condition before a different type of cut, such as a side cut, is considered.

Figure 6 is a flow diagram showing the entire first computer program. Note that after Part E has been completed, information is punched on a card concerning the minimum cycle times, which would correspond to the first cycle in a series of cycles. The computer then increases the length of the shuttle car hauling distance by the feet of advance made in the preceding cut and recomputes the relationships and time of hauling the coal away from the miner in the next cut. This process continues as the computer simulates the mining of successive cuts until the change point of the shuttle cars can be advanced closer to the miner. At this point, the shuttle car change distance and remaining travel distance are altered to reflect the location of the new shuttle

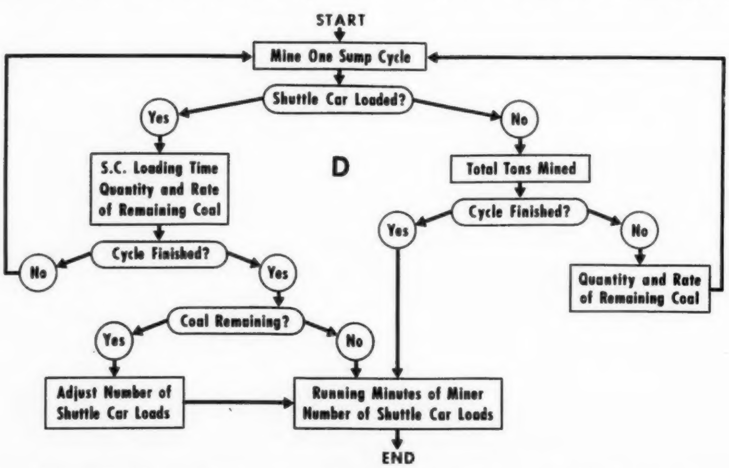


Fig. 3. Flow diagram of mining portion of program shows various decisions required

car change point. The computer will then complete the series of cuts. Information concerning the last full cut in the series is punched on a card. then the total mining times for a one shuttle car and two shutle car operation, as well as the total tons and running times of the miner and shuttle cars are punched on a different card. The computer then starts the process over again in a different section location.

When all series of one cycle type have been completed, all of the calculations are repeated for a different height. When all the heights have been considered, a different condition is introduced and the effect of this condition is computed for all heights. Finally, after one cycle type has been considered in all combinations of heights and conditions, a different cycle type is introduced and the whole process starts over again.

Final Card Contains Information for Setting Standards

In the second pass (figure 7), the participation of the various conditions affecting the miner, working heights and roof support conditions to be used in the standard are introduced along with basic allowances for breakdowns and other types of delays. Roof support cycle information is brought in, with the computer selecting and storing only that information which will be required in the standard and bypassing the rest. Then the punched output of the first program is fed in. Again the computer selects only the information it needs for the standard and bypasses the rest. As these miner workloads are coming in, the minimum and maximum cycle times are compared with roof support cycle times under various roof conditions, and the computer determines what effect, if any, the roof support has on production.

After all the data has been fed into the machine, it then calculates and punches on cards the production per shift for each combination of condition and height, then computes the final standard. The last output card contains the standard tons per shift and running hours per 100 tons of coal produced for the continuous miner, shuttle cars, and roof support equipment. This latter information is used in setting repair and maintenance standards.

The actual running of this program on an IBM 650 computer is a simple task. The first program is placed in the card reading hopper. This is a deck of cards on which the program has been key punched. It is

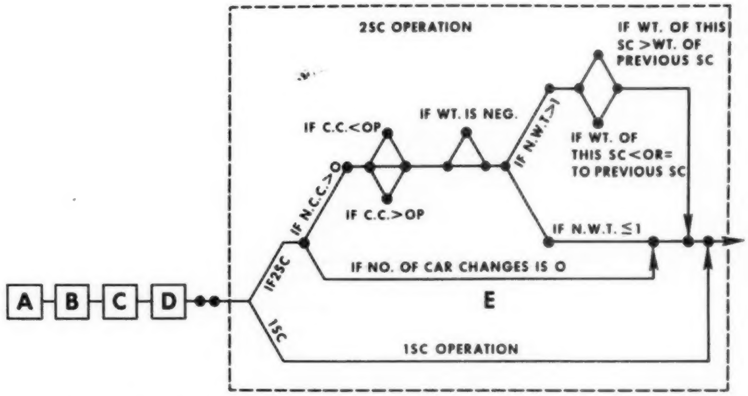


Fig. 4. Haulage portion of program for IBM 650 computer. In Parts A, B and C the data is brought into the computer. Part D is the portion which calculates the shuttle car loading time and the tons mined. In Part E the computer determines the effect of the shuttle cars traveling to the discharge point, dumping, and returning to the miner

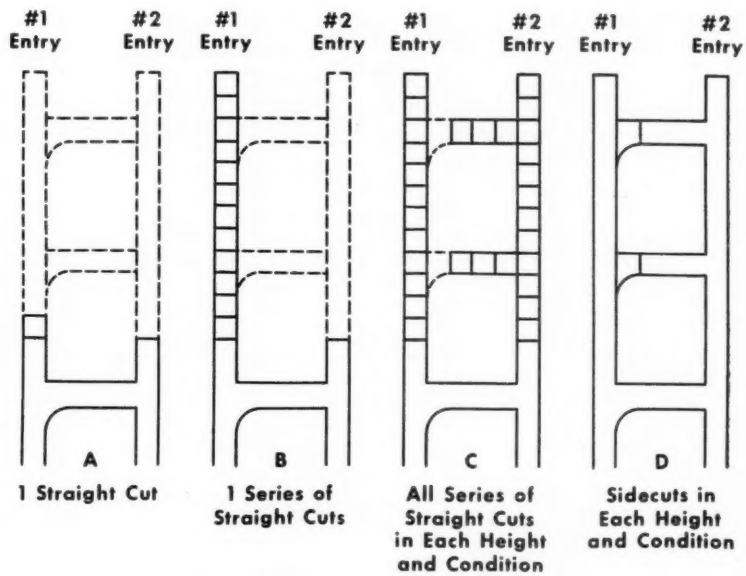


Fig. 5. Sequence in which computer "mines"

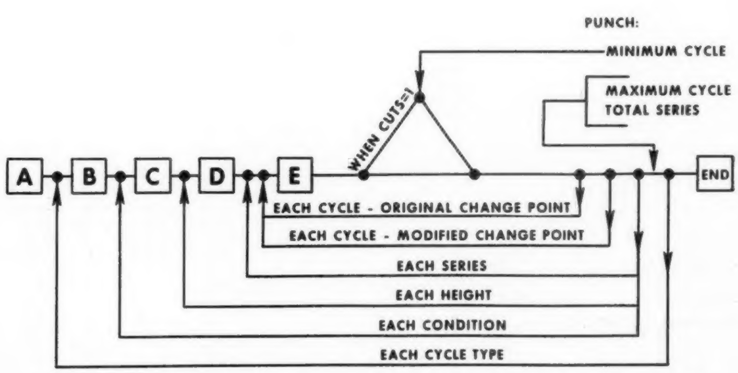


Fig. 6. First pass for IBM 650 computer. Flow diagram shows the entire first computer program

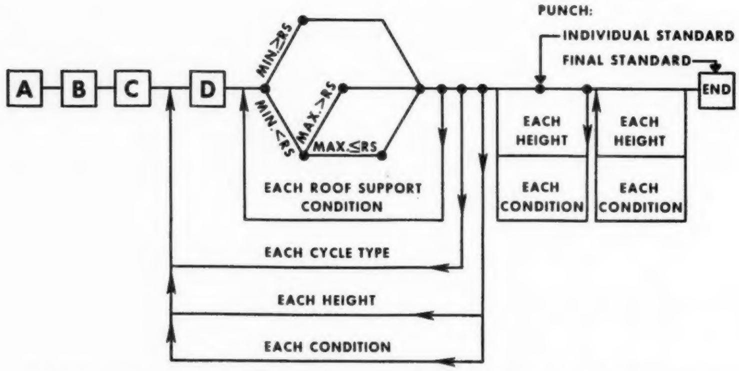


Fig. 7. Second pass for IBM 650 computer. In this case the participation of the various conditions affecting the miner, the working heights, and the roof support conditions to be used in the standard are introduced along with basic allowances for breakdowns and other types of delays. After all the data has been fed into the machine, it then calculates and punches on cards the production per shift for each combination of condition and height, then computes the final standard

kept intact and can be used hundreds of times. The deck of cards containing the data is placed on top of the program deck, 11 switches on the 650 console are set and the "start" button is pushed. Then nothing need be done until the computer has completed its work of computing and punching cards. The second program is then placed in the card reading hopper, followed by a deck of key punched data cards. The punched output from the first program is placed on top. A "reset" button is pushed and then the "start" button. When the computer stops, the calculation of the production standard is complete.

Depending upon the complexity of the mining plan and the number of conditions and heights considered, the first program will take from 20 minutes to as long as four or five hours to run. To obtain the same information with comparable accuracy, a man would have to work ten days with a desk calculator.

The second program can be run in 20 minutes or less.

Example Illustrates Value of Computers as Aid to Planning

To illustrate the value of this simulation program the writer will describe a series of nine evaluations, and discuss the time required to prepare the data decks, the computer time required for the analysis, and the results.

As a starting point for these evaluations, let us assume one section which is mining six ft of coal using one continuous miner, two shuttle cars which discharge into mine cars, and one stoper in the roof support cycle. Let us further assume that it is a two-shift operation and that a six-man crew is used on each shift.

Preparing the data for this section required 2½ hours and the computation of the production standard required 53 minutes on the computer.

First evaluation. It was made to determine the effect of installing doors as a means of moving the shuttle car change points closer to the faces. Twenty-five minutes were required to prepare the data and 26 minutes of computer time was involved, proving a tonnage gain of 16 tons per shift.

ORIGINAL PLAN AND STANDARD

PREPARATION OF DATA 2½ HRS.

COMPUTER RUNNING TIME 53 MINS.

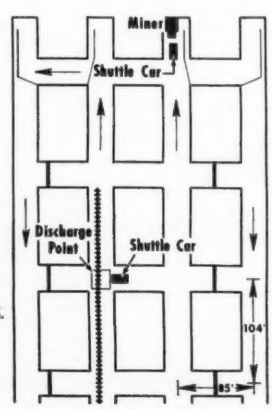


Fig. 8. Original development plan for an example cited in text to illustrate value of simultation program

Second evaluation. This evaluation was made to determine the effect of increasing the discharge rate of the shuttle cars by 20 percent. It required one minute to prepare the data, 26 minutes of computer time, and proved a tonnage gain of one ton per shift.

Third evaluation. Purpose was to determine the effect of replacing the tail track with a 36-in. belt conveyor. It required 25 minutes to prepare the data and 26 minutes of computer time. A tonnage gain of 42 tons per shift was shown.

Fourth evaluation. This was made to determine the effect of adding a seventh man to the crew to reduce the roof support cycle time and to help relieve during the lunch period. Three minutes were required to prepare the data, three minutes to compute it, and the result was a tonnage gain of six tons per shift.

Fifth evaluation. It was made to determine the effect of adding a spare continuous miner to the unit and going to a three-shift operation. This decreases the utilization of the miners by 25 percent. The evaluation required one minute to prepare the data, three minutes of computer time, and proved a gain of 24 tons per shift.

Sixth evaluation. It was made to determine the effect of changing the center distance of the entries from 85 ft to 69 ft and the center distance of the crosscuts from 104 ft to 80 ft. This required 23 minutes to prepare the data, 26 minutes of computer time, and proved a tonnage gain of 18 tons per shift.

Seventh evaluation. Purpose was to determine the effect of increasing the mining rate ten percent by using a different bit and improving the practices associated with bits. This required two minutes to prepare the data, 26 minutes of computer time, and proved a tonnage gain of 16 tons per shift.

Eighth evaluation. The eighth evaluation was made to determine the effect of putting a loading machine and one shuttle car behind the miner instead of two shuttle cars. Twelve minutes were required to prepare the data and 52 minutes to compute it; the result was a tonnage gain of 38 tons per shift.

Ninth evaluation. The eight evaluations were all made separately and each was compared to the original plan. Naturally, if more than one of these changes were to be evaluated simultaneously, the total result would be different than the sum of the indi-

Table I. Summary of evaluations

	Data prep. in min.	Computer time in min.	Tons gained
1. Install doors	25	26	16
2. Increase discharge rate	1	26	1
3. Replace track with belt	25	26	42
4. Add man to crew	3	3	6
5. Add spare continuous miner	1	3	24
6. Reduce centers	23	26	18
7. Increase mining rate	2	26	16
8. Add loading machine	12	52	38
9. Combined effect	28	26	176
	2 hrs.	3 hrs. 34 min.	176 tons

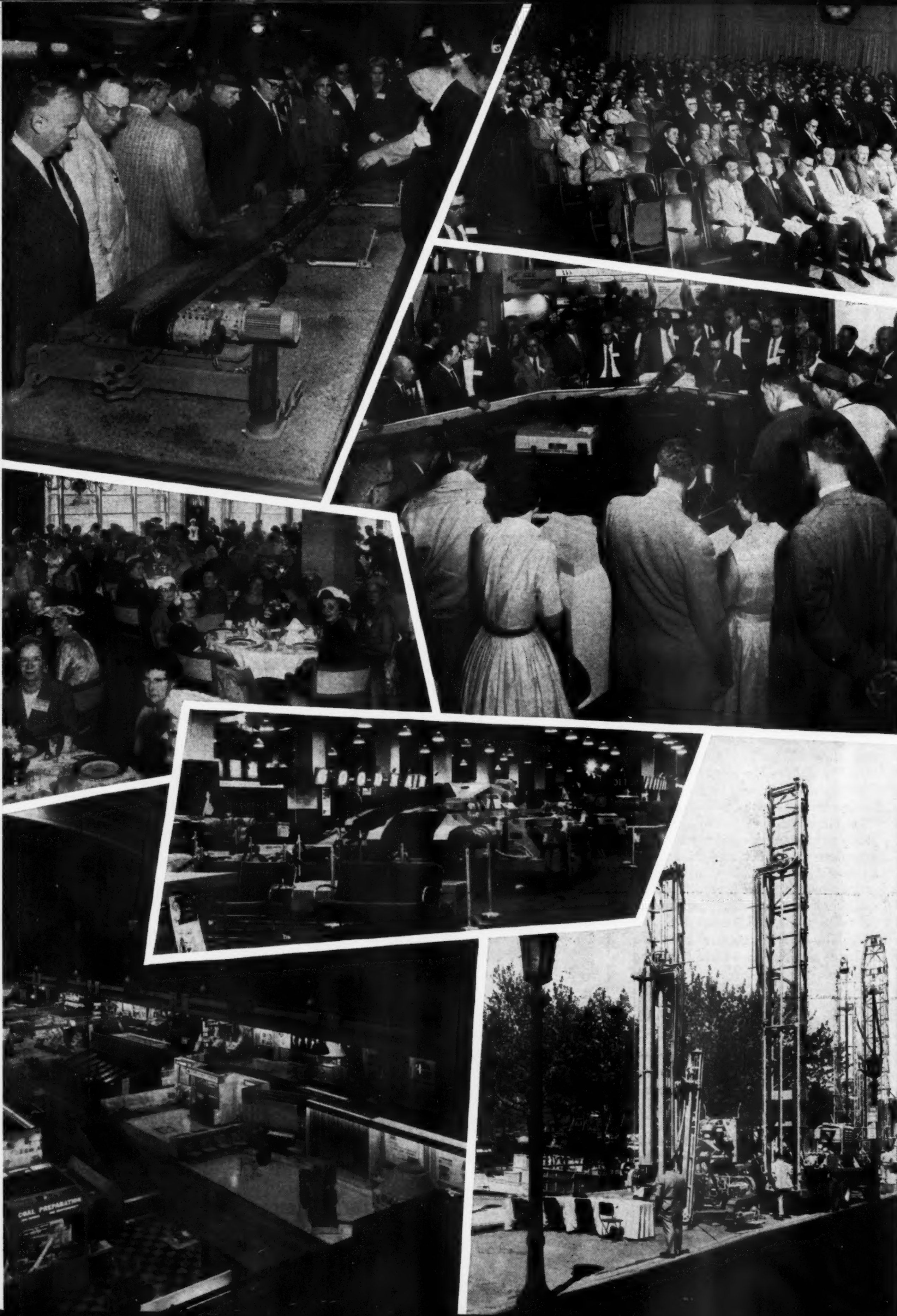
vidual effects on production. Therefore, the ninth evaluation combined all of the previous eight changes to determine the effect of adopting them all. This required 28 minutes to prepare the data, 26 minutes of computer time, and proved a total tonnage gain of 176 tons per shift. A summary of these nine evaluations (Table I) will readily indicate the value of an electronic computer as a tool for mine management. With an expenditure of time totaling only two hours, an engineer proved a gain in tonnage of 176 tons per shift, or 528 tons per day by using a computer. The computer ran approximately 3½ hours.

In a very limited time the computer calculated the results of a series of methods changes that would have taken countless hours to develop by conventional means. It cannot be said that the computer is responsible for the gain of 528 tpd, but the computer did make it possible to arrive at the potential of the proposed methods changes in a matter of hours. The direct savings attributable to the computer, in this one series of evaluations, more than offset the cost of renting and operating a computer installation for one month. It is not difficult to imagine the savings that can be realized when a computer installation is utilized to its full potential on problems such as those that have just been described.

Computers Can Be Used to Unshackle Creative Thinking

The advantages of computers can be summarized as follows. First, they can bring about cost improvement when applied to accounting functions, such as payroll and other forms of data processing, and in performing routine type calculations. Second, because of their speed, they can provide timely answers to many difficult problems which would never be solved by hand because of the time and cost required for a solution. Third, they permit the use of complicated forms of higher mathematics in the solution of problems by persons who are not familiar with the processes involved. Finally, computers can be used to unshackle creative thinking by removing the time-consuming process of hand calculations and by allowing the thought process to soar in the scope and complexity of problem solutions.

In conclusion, capable as these machines are, they are useless without being provided with intelligence by engineers and technicians. Every move the machines make must be dictated, and the effect with which they are utilized is dependent upon the intelligence with which they are programed. It is more evident than ever that our technical organizations must be staffed with engineers who can learn the know-how and know-why of this 20th Century tool. When this is accomplished, we will have more time available for constructive planning and the direction of effort into the areas of improving methods and reducing costs.


COAL PREPARATION

1961 AMC COAL SHOW

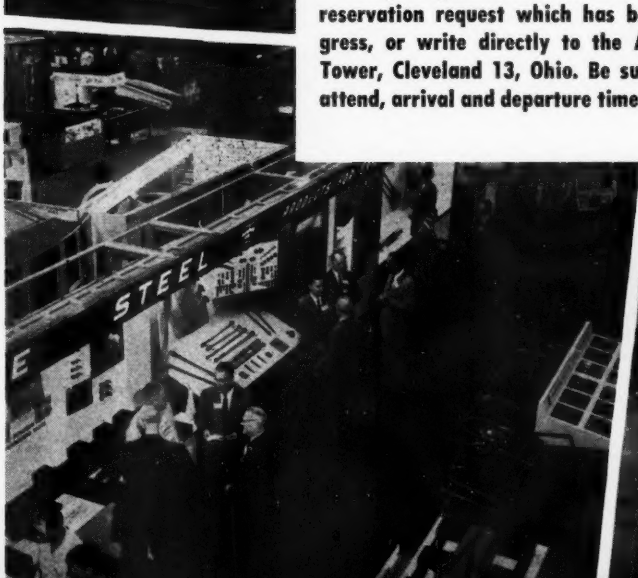
Cleveland—May 15-18

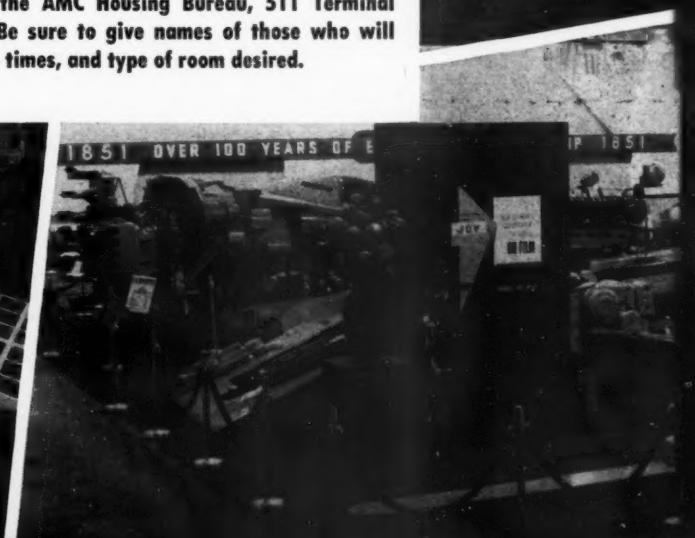
Coal Show attendance is accepted as a "must" by the coal industry because it offers so much, and in such a convenient form.

Exposure to the newest concepts of producing and preparing coal . . . on-the-spot inspection and comparison of the latest in all types of mining equipment, displayed by over 200 leading manufacturers . . . an opportunity to compare notes with progressive mining men from all over the world—all this is available in the brief period of four days. There is plenty to do for the ladies too, so bring them along.

It's an experience that can't be duplicated!

Get your plans set now. For hotel accommodations, send in the reservation request which has been distributed by the Mining Congress, or write directly to the AMC Housing Bureau, 511 Terminal Tower, Cleveland 13, Ohio. Be sure to give names of those who will attend, arrival and departure times, and type of room desired.





Radio Communications in Small Mining Operations

The Citizens Radio Service has provided this operator with a means for reduced mining costs through voice communications

By A. W. WOODS
Mine Superintendent
Trace Elements Corp.

EFFICIENT mining of bedded, discontinuous and small uranium deposits in the Browns Park formation near Maybell, Colo., prevents the utilization of large mining equipment. In order that dilution be kept to a minimum, small shovels and tandem-axle dump trucks are used for mining and transporting the ore. Because stripping and mining operations are conducted simultaneously in several pits and because most of the Browns Park ore is radiometrically out of equilibrium, an efficient, inexpensive, and reliable communications system is essential.

Needed Rapid Communications

An ore controlman using a Geiger counter was assigned to each shovel that was working in the ore. His duties were to control the ore grade and direct the loaded material to its proper destination.

Early in 1958, more efficient grade control than was previously possible was obtained by installing a Beta-Gamma assay unit in a small trailer house. This trailer was equipped with an exterior sample chute and located just outside the pit entrance.

The ore controlman grab-sampled each truckload and directed the truck driver to the proper stockpile on the basis of gamma count. He also sent the grab sample by the driver who deposited it in the exterior chute at the assay trailer. Since disequilibrium conditions sometimes caused the ore controlman to misdirect the ore, the loaded trucks were detained until a Beta-Gamma assay could determine the true ore grade. It became evident that rapid communications would eliminate the truck wait time and reduce mining costs.

Investigation disclosed that purchase and installation of industrial type two-way radios would cost about $600 a unit. Small "Citizen Band" transceivers, operating on the 460 to 470 megacycle (mc) band would cost from $70 to $80 each. Because distances greater than two to three line-of-sight miles were not of immediate concern, equipment using the frequencies available in the Class B Citizens Radio Service was purchased.

Low-Cost Transceivers Installed

During the summer of 1958, five transceivers costing an average of $75 per unit were put into use. At that time, a one-yd shovel and three, tandem-axle dump trucks supplied the major portion of the production at Maybell. Transceivers and ground plane antennas were installed in the dump trucks, the assay trailer, and on a bucket loader located in the ore receiving area near the plant.

The above arrangement not only provided the communications needed to reduce truck wait time but also furnished means whereby each load of ore could be redirected while in transit. The truck drivers deposited their samples in the chute at the assay trailer while in motion, and if necessary, the assayer would redirect the drivers by means of the Citizens Radio before they reached their destination. The five units have proved satisfactory for short range line-of-sight communications and at the present time are in use on a five day work week basis.

In September 1958, amendments to Part 19, Volume VI of the Federal Communications Commission regulations made available 23 party-line channels on the Class D Citizens Band. Crystal-controlled transceivers capable of transmitting and receiving ten miles in open country were made available by numerous manufacturers. Two simple-to-assemble transceiver kits were purchased at a cost of $42.95 each. These have been in operation five days per week for several months and have given excellent service. When present plans materialize, 15 units will be in use.

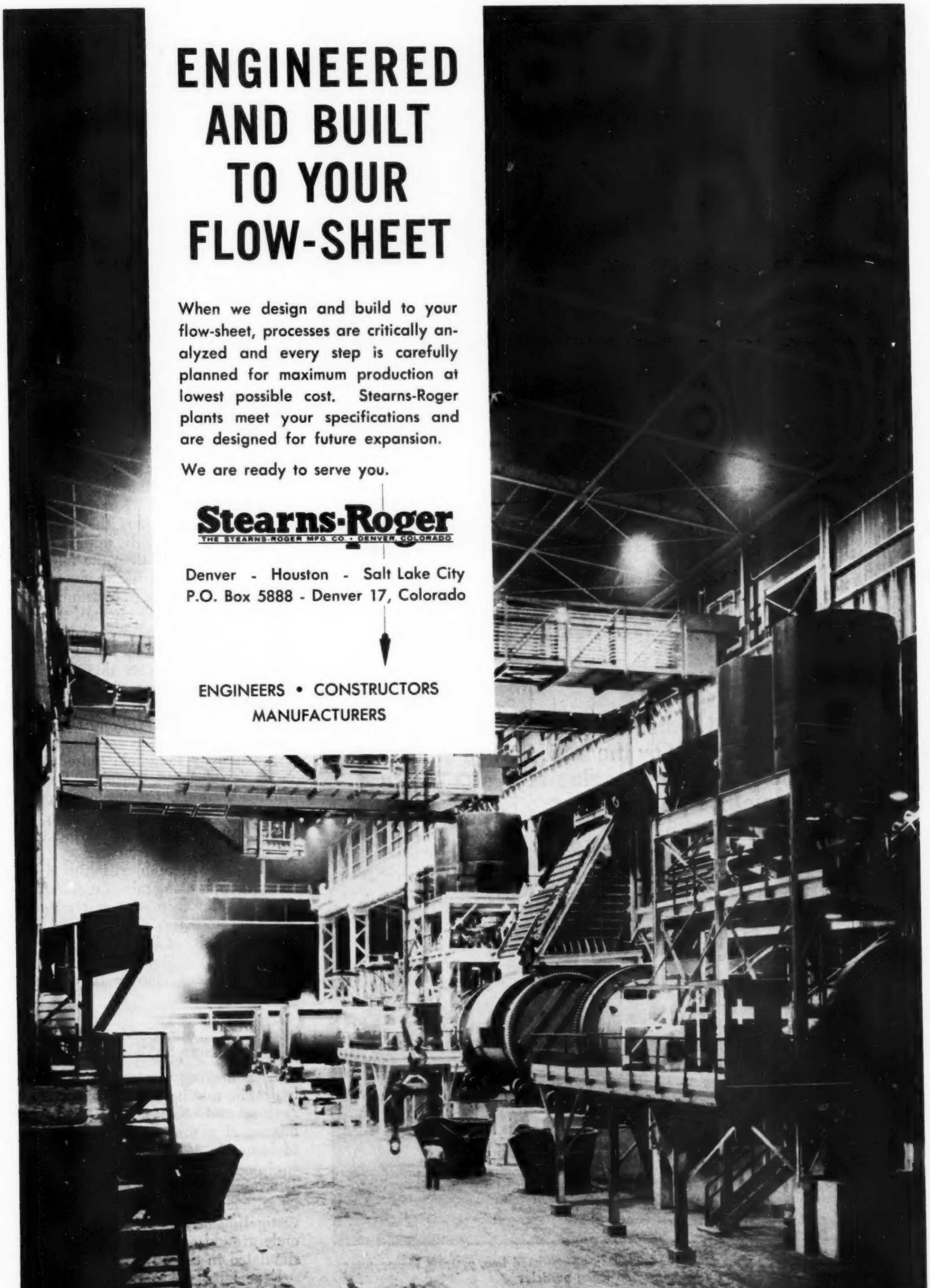
Citizens Radio Service

The Citizens Radio Service, which was established by the FCC in 1947, includes Class A, Class B, and Class D stations that are intended primarily for personal or business short-range voice communication. Frequencies in the 460 to 470 mc band were assigned to Class A and B stations, and frequencies on the 11 meter band ranging from 26.965 mc to 27.255 mc were assigned to Class D stations.

Forty-eight channels in the 462.55 to 466.45 mc band are available for assignment to Class A and B stations. Class B stations may, in addition to the 465.00 mc frequency, use any Class A frequency in the ranges of 462.55 to 463.20 mc or 464.75 to 466.45 mc. However, any Class B equipment using these frequencies must comply with Class A standards. For all practical purposes, Class B units are limited to line-of-sight contacts.

In 1958 the FCC established the Class D station in the 26 to 27 mc

(Continued on page 57)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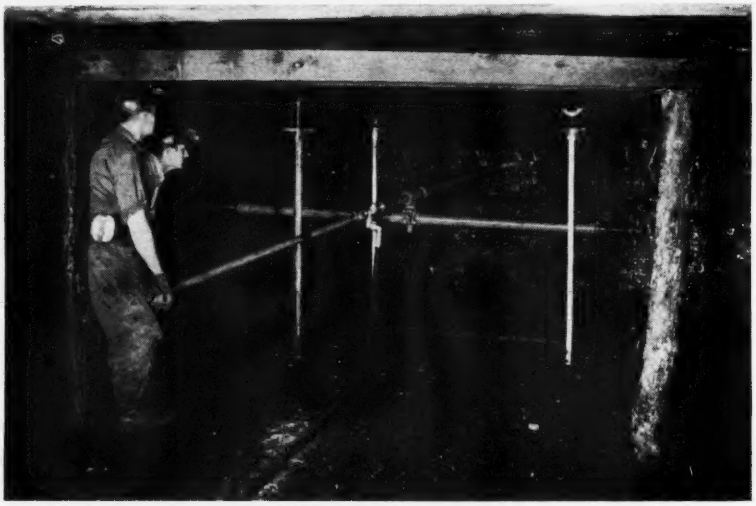


The monitor consists of a two-in. double extra-heavy pipe with a nozzle holder welded to one end and a Chiksan swivel joint screwed to the other. A one-in. high-pressure hose connects the high-pressure pipe to the swivel joint. An offset pipe T-handle welded to the monitor permits the operator to manipulate the machine. Note that the monitor is mounted on an 11-ft horizontal bar fastened at each end to a screw timber jack by means of a U-bolt

Bureau of Mines Research in Hydraulic Coal Mining

Coal can be mined hydraulically. Here are the results of a field investigation by the U. S. Bureau of Mines, covering such aspects as nozzle size, water pressure and mining method

A sliding multiplate glass shield, supported on an overhead line, protects the operator from spray and flying particles

By J. J. WALLACE
Supervising Mining Methods Research Engineer
Mining and Preparation Section
U. S. Bureau of Mines

HYDRAULIC mining of loosely consolidated material is not new; however, application of the concept to mining coal from a solid face has only recently been seriously attempted. Since 1935 the Soviet Union has experimented in mining coal from a solid face with water under high pressure and fluming or ditching the coal by gravity from the face to a sump from which it is pumped to the surface. Recent articles indicate that these experiments have advanced to the commercial stage. According to a Russian article reviewing mining operations at one mine and published in 1956, production after a 1½-year period was 44 short tons per man-shift with a recovery of 87 percent. These articles further report that the production from hydraulic mining is 2½ to 3 times greater than the mines in the same area using conventional equipment. The cost of hydraulic mining is reported to be one-half the cost of conventional mining and nearly equals the cost of strip mining. These same articles indicate that the Russians are using pressures ranging from 515 to 588 psi with nozzle diameters up to 1.08 in. They further indicate that the coal is fractured with explosives by long-hole pulsed infusion. New Zealand, Germany, Poland, England, China, Czechoslovakia, Japan, and France are investigating the possible use of hydraulic mining and/or transportation of coal.

At Bonanza, Utah, gilsonite, a hydrocarbon, is being mined successfully from a solid face with water under 2000 psi pressure. The mineral has a specific gravity of 1.04 compared with 1.30 for bituminous coal, and has fracture planes similar to cleavage planes in coal.

Experiments Conducted in Pennsylvania Mine

After making a literature survey on hydraulic mining in Russia and New Zealand and observing the hydraulic mining of gilsonite, the U. S. Bureau of Mines in 1958 started assembling equipment for a field investigation to determine if American coal beds could be mined hydraulically. The field investigation was decided upon because underground conditions could not be simulated in the laboratory.

Experiments in hydraulic mining of

coal were conducted in the hard bituminous Pittsburgh coal bed in a mine leased from Rochester & Pittsburgh Coal Co. and located in Indiana County, Pa. The bed is relatively flat lying. The working face is in a two-acre block of solid coal 800 ft from the mine entrance. The coal averages 66 in. in thickness and is overlain with 10 to 12 in. of draw slate. The roof consists of rider coal and then shale. Crossbars 5 in. by 7 in. by 12 ft are set on four-ft centers for roof support. The coal has pronounced face and butt cleats, is interspersed with numerous streaks of impurities, and has two hard binders, each from two to three in. thick. They lie 18 and 44 in. below the draw slate.

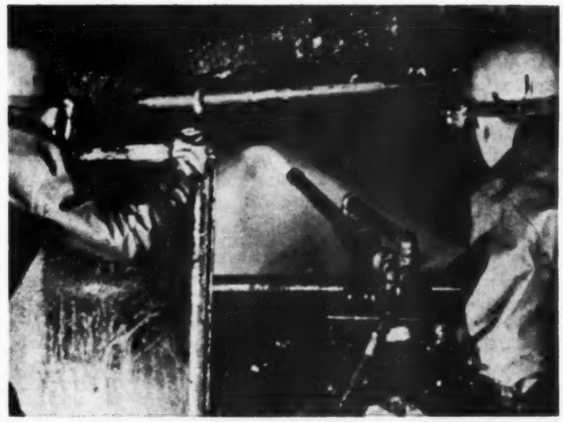
The surface plant consists of a triplex plunger pump capable of producing up to 300 gpm at 4000 psi pressure. The pump is connected directly to a 900-hp diesel engine obtained from Navy surplus. Mine water (pH 3.4) is pumped from the mine drainage ditch to a reservoir adjoining the pump engine building. After use, it is pumped to a surface settling basin.

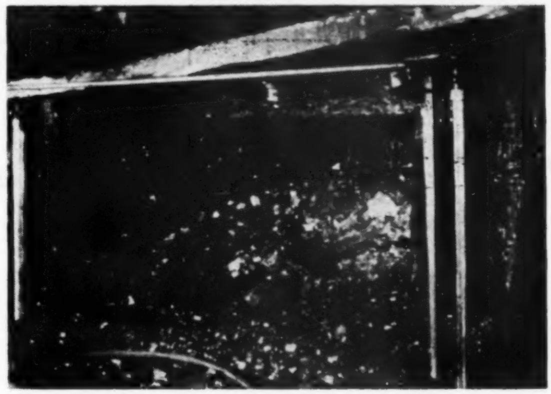
Water is pumped into the mine through a four-in. double extra-heavy seamless carbon steel pipe. Welding neck flanges with tongue and groove facings and "spirotallic" gaskets were used to connect the pipe. Each flanged pipe was tested at 8000 psi pressure.

Any Desired Pressure Up to 4000 PSI Can Be Obtained

The monitor was built from a two-in. double extra-heavy pipe with a nozzle holder welded to one end and a Chiksan swivel joint screwed to the other. A one-in. high-pressure hose, also tested at 8000 psi pressure, was connected from the high-pressure pipe to the swivel joint. An offset pipe T handle was welded to the monitor so the operator could manipulate it. The monitor is mounted on an 11-ft horizontal bar fastened at each end with a U-bolt to a screw timber jack. This bar can be raised to any desired height. An extra screw timber jack is set about one ft from each end against the horizontal bar as a safety measure should the U-bolts or supporting jacks work loose. A conical base, welded to a ring through which the monitor is assembled, is clamped into a saddle receptacle. This arrangement permits both horizontal and vertical movement of the monitor.

The operator wears a rubberized suit, shin guards, and a face shield for protection. In addition, a sliding multiplate glass shield, supported on its overhead line, protects him from spray and flying particles.





(Top) Mining draw slate. The volume of water discharged from the monitor depends upon the size of the nozzle opening and the pressure. (Bottom) Cut of mined coal and draw slate ready for loading. When the optimum rate of mining is attained, the next phase will be to integrate hydraulic mining with hydraulic transportation

In mining the coal and slate, the horizontal bar is set at three elevations. In the first setup, the horizontal bar is mounted about eight in. above the mine bottom. To make the undercut, the monitor is positioned near the right rib, moved to the center, and then placed near the left rib. In this way, an undercut about 14 in. high and six to eight ft deep is made across the face. The horizontal bar is raised to 34 in. above the mine floor. With similar positions of the monitor, the remaining coal is mined starting with a shear on the right rib. After the coal has been brought down, the horizontal bar is raised another six in., and the draw slate is taken down.

A small centrifugal pump picks up the water from a reservoir and discharges it into the suction line of the high pressure pump. The high pressure pump then discharges the water through a bypass valve back into the reservoir. By regulating this bypass valve, the water is diverted into the discharge line, and any desired pressure up to 4000 psi can be obtained. The volume of the water discharged from the monitor depends upon the size of the nozzle opening and the pressure. Operational instructions between inside and outside are through an intercommunication system, with each message repeated by the receiver to prevent any misunderstanding. As an added safety feature, a push button at the face is available to shut off the fuel supply to the diesel engine should the intercommunication system fail.

$\frac{3}{8}$-In. Nozzle Proves Most Effective

Tests were made with nozzles having openings of $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, and $\frac{1}{2}$-in. to determine the rate of cutting. Most of the tests were made at pressures of 4000 psi because earlier tests indicated the higher the pressure the faster the rate of cutting. With the $\frac{1}{8}$-in. nozzle, practically no coal was cut. The $\frac{1}{4}$-in. nozzle mined at the rate of $\frac{1}{2}$ tpm. The $\frac{3}{8}$-in. nozzle mined coal at the rate of $\frac{3}{4}$ tpm. Only one cut was made with the $\frac{1}{2}$-in. nozzle. The highest pressure that could be attained with this nozzle was 3300 psi. The cutting rate was less than with the $\frac{3}{8}$-in. nozzle and greater than the $\frac{1}{4}$-in. nozzle. All the cuts were six to eight ft deep. Cuts were made on the face cleats, butt cleats, and 45° to the face cleats. Indications so far are that the direction of the cleats does not materially affect the rate of cutting.

Penetrating tests were made with the $\frac{1}{4}$ and $\frac{3}{8}$-in. nozzles to determine the effect on cutting by changing the degree of the inside taper with a corresponding change in length of straight section. The monitor was held in a fixed position (no vertical or horizontal motion of the monitor) for one minute, and using a $\frac{1}{4}$-in. nozzle with pressure of 4000 psi, a maximum penetration of 36 in. was obtained. With a $\frac{3}{8}$-in. nozzle, a maximum penetration of 60 in. was made. These are maximum penetrations because the water trying to get out of the hole counteracts the jet stream entering the hole. Slot tests then were made to give the water a chance to escape. The handle of the monitor was set between two timber jacks to prevent lateral movement of the monitor. The slots were made between the two partings, which are 26 in. apart because the coal is the most uniform in this part of the bed and the two partings are well-defined limits of the slots. The 26 in. are traversed with water pressure of 4000 psi in 10-second intervals, and the depth of penetration was measured from the nozzle. This was repeated 12 times. An additional run of five minutes was made to determine the maximum penetration. With the seven $\frac{1}{4}$-in. nozzles with inside tapers ranging from 8° to 16°, the depth of penetration for the first 10-second interval ranged from 26 to 42 in.; the second from 32 to 51 in.; the third from 42 to 57 in.; and the fourth from 46 to 63 in. Similarly with the two $\frac{3}{8}$-in. nozzles, the depth of penetration for the first 10-second interval was 36 and 38 in.; the second was 51 and 63 in.; third was 69 to 73 in.; and the fourth was 80 and 86 in. In the additional five-minute interval, depth of penetrations ranged from 73 to 94 in. for the $\frac{1}{4}$-in. nozzles and 137 to 140 in. for the two $\frac{3}{8}$-in. nozzles. These tests definitely proved that the rate of cutting decreased as the distance from the nozzle increased. However, the one set of tests did not show any marked difference in cutting by varying the degree of taper in the nozzle.

Monitor Is Mobilized

Experiments to date proved that the Pittsburgh coal bed can be mined hydraulically. The results are somewhat misleading because the monitor could not be advanced manually, and from the Bureau's experience, the rate of cutting decreases considerably as the distance from the nozzle to the face increases. This has been remedied by mounting the monitor on an 8BU Joy conventional loading machine whereby hydraulic jacks will move the monitor vertically and horizontally, and the distance from the nozzle to the face will be controlled by the position of the machine.

Laboratory testing will be done at the mine to determine the best nozzle design for the most effective cutting rate. When the optimum rate of mining is attained, the next phase will be to integrate hydraulic mining with hydraulic transportation.

AMC ANNUAL BUSINESS MEETING

(Continued from page 33)

Senator Mansfield declared that we are engaged in a struggle for survival and that no American can divorce himself from the large stake which our country has in foreign policy.

AMC Directors Elected

Nominations for Directors of the American Mining Congress were submitted by L. J. Randall, Chairman of the Nominating Committee. They included eight men, each nominated for a three-year term: Christian F. Beukema, President, Oliver Iron Mining Division of U. S. Steel Corp.; George J. Clark, President, Reading Anthracite Corporation; Charles R. Cox, President, Kennecott Copper Corporation; Austin Goodyear, President, Hewitt-Robins Incorporated; George H. Love, Chairman of the Board, Consolidation Coal Company; Robert P. Tibolt, President, Eastern Gas and Fuel Associates; Thomas M. Ware, President, International Minerals and Chemical Corporation, and S. H. Williston, Executive Vice President, Cordero Mining Company. These nominees were elected by unanimous ballot.

At the Board of Directors meeting immediately following the annual business meeting, all present officers were reelected for the year 1961 and the Declaration of Policy adopted at the Convention in Las Vegas, Nevada, in October received unanimous approval as an expression of the policy of the American Mining Congress. In addition the Board authorized the Mining Congress to co-sponsor a proposed International Symposium on Ground Control and Rock Mechanics to be held during 1964 and took appropriate action on other routine matters requiring attention.

Tax, Land and Water Use Committees Meet

The annual all-day Tax Forum, with more than 100 mining tax men, attorneys and accountants in attendance, was held on December 5 under the direction of Lincoln Arnold, Chairman of the American Mining Congress Tax Committee. The morning session was devoted primarily to talks by two guest speakers. Leo H. Irwin, Chief Counsel of the Ways and Means Committee, discussed the legislative outlook for the coming year, and Robert A. Klayman of the Treasury Department's Legal Advisory Staff outlined the problems involved in the recently proposed regulations on the aggregation of "properties" for percentage depletion purposes.

The afternoon was divided into two discussion groups; one covered the problems created by the Cannelton case and the Gore Amendment on the computation of "gross income from mining," and the other was devoted to analysis of the Treasury's proposed regulations on property.

Walter F. Schulten, Vice President, Consolidation Coal Co., presided over the Land and Water Use Committee Meeting, which was also held on December 5. Plans for the National Conference on Water Pollution, held in Washington, D. C. a week later, were discussed at length. Other matters taken up by the committee were a brief review of legislative developments and plans for a field trip to Eastern Kentucky next May. Following luncheon, C. Fred Gurnham discussed the work of the National Technical Task Committee on Industrial Wastes, on which he represents the mining industry, and the Industrial Water Use questionnaires being distributed by that organization to obtain information concerning water use by industry.

RESEARCH SCIENTIST,

Care and Feeding of

By JACK W. DUNLAP
President
Dunlap and Associates, Inc.
Stamford, Conn.

Future growth of the mining industry will be closely related to the emphasis placed on research, if the past 50 years of industrial growth can be taken as a guide post

THE President's Materials Policy Commission report of June 1952 indicated that U. S. consumption of minerals in 1950, including fuels, was six times that of 1900. The report went on to say, "This vast drain, greater today than yesterday, and inescapably greater tomorrow than today, upon resources that cannot be renewed has become the most challenging aspect of our present day economy." Later in the report the statement was made, "We shall have to increase the over-all effort of materials technology and plan its whole pattern of research better than it has ever been planned before."

The coming space age provides a host of opportunities for the mining industry, but to seize the advantage of these opportunities will require an increasing emphasis on research and development. Industrial growth of the United States in the past 50 years stems in a large measure from technological advances—advances based on research. It is, therefore, reasonable to expect that future growth of the mining industry will be closely related to the emphasis on research on techniques of exploration, mining, production, recovery, beneficiation, processing and products. In view of this, a company whose management has not recently taken a long hard and critical look at its research organization, its research men, and its goals and objectives in terms of the demands of the future, might be well advised to do so in the near term.

While the title of this article is facetious, the problem of effectively managing a group of researchers is serious. It therefore seems appropriate to discuss some of the personnel and organizational problems, and to raise some pertinent questions.

Characteristics of Research Men

In developing a research organization, we must consider the nature of the men we are dealing with. They are better educated and more intelligent than the average, independent, critical, and somewhat resentful of authority and particularly of close operational control. In general, they are quick to criticize and resent criticism. Their orientation is towards ideas and things, rather than towards people, and it is this characteristic that often makes it difficult for them to work in supervisory roles.

As a group, scientists appear to be less motivated, beyond a given point, by monetary rewards than are other groups in industry. Their goals appear to be more in terms of personal satisfactions from solving problems and in attaining prestige and recognition in the scientific world. Corporate advantages stemming from their work often are viewed in terms of contributions to the group, national or international welfare, rather than in terms of their individual welfare.

Building a Staff

The missing element in many research organizations today is imaginative audacity. The willingness to think boldly, to seek multiple approaches to a problem, and to initiate and activate studies is one of our great needs.

Bold thinking is often disturbing to management; it upsets their plans and appears to threaten their positions as managers. Their reaction should be just the opposite, for it is the development and encouragement of the bold thinkers that give status to the manager and to the organization.

In selecting researchers, management is often too preoccupied with getting personable team workers—men who are "sound," "level-headed," "have-their-feet-on-the-ground," and are cooperative—that more often than not are dull, prosaic, and unimaginative. As a result, the organization turns into a smooth-running machine devoted to replicating the commonplace with little effectiveness for attacking the novel problem or making

a break-through in science or the industry.

Developing the Research Organization

In any research organization, the chief function is to bring to bear upon problems the creative imagination and technical skill of highly trained men. In some cases, this can best be done by a single individual, in others by a group within a single discipline; but more and more frequently, broad system problems are brought to the laboratory which require a multi-discipline team.

In any case, certain constraints are imposed on the technical man in terms of time and money. Further, the problem solution must be in a form which is understandable and acceptable to management, and it must be practical. A further constraint is that the scientists must work within the framework of the organization's operating policy. In order to do this, it is necessary that operating policies be clearly stated and for management to see that technical people understand them. Operating policies should be discussed carefully with technical personnel before being initiated on a trial basis, and then, after a period of time, they should be reviewed for the purpose of correcting any unforeseen difficulties that may have arisen. Time spent here does much to eliminate misunderstandings between staff and operating personnel.

Role of Research Administrator

A good research administrator should be a good scientist but not so academic that he loses himself in technical details of the business. He must be able to select research problems which appeal to the staff but which also have high economic potential. He must keep his staff busy on problems necessary to support the organization, yet he must give them some time and freedom to explore areas of their own personal interests.

If the administrator has a good idea, he should turn it over to the staff to solve and publish. This is one of the most difficult facts that an administrator has to learn. He cannot simultaneously do a good job of administration and a good job as a technical person. There are not sufficient hours in the day, nor is he able to separate his interests and the demands on his time and energy to permit doing a good job at both—a hard decision, but one which must be faced.

Administrators at all levels should take particular care to coordinate the work of the professional staff with the various support groups within the organization. They must be prepared to protect professional people from administrative pressures and details of day-to-day operations, even though it means management itself must absorb these pressures. In return, management must insist on results of high quality, produced on schedule, and in sufficient quantity to justify costs.

Administrators must not insist that theirs is the only way to accomplish a goal; rather, they must lead the staff into developing plans and controls which have been determined to be needed and practical.

They should encourage their staffs to develop their skills and knowledge further. This may be done through taking courses, special readings, working on new but related problems, attending technical meetings, participation in community affairs, or developing new social skills, to mention a few. The crux of the matter is not so much what the individual does but that management is interested in him as a person.

"Rewarding" the Scientist

When a technical man has proved that he is both creative and competent, we wish to reward him. Too often, administrators feel that such a man will be rewarded by the same things which they themselves hold in high regard. They blindly assume that he will be properly rewarded by appointment to an administrative post in the corporation with attendant increases in salary.

Some men make the change easily, others are bored with administrative work and long to return to research, and a few refuse staff appointments—these are the wise ones. Management must, therefore, find other means of rewarding these men and manifesting sincere respect for them. In the writer's organization, this has been attempted by establishing the position of "chief scientist," which is comparable in salary and level of responsibility to the position of a vice president.

Perhaps the most critical element in developing a satisfactory research climate is management's attitudes. The motives, values, and operating philosophy of management in regard to research color all levels of management and the technical staff. Management must be understanding and sympathetic to the problems of the research worker if his creativity is to be stimulated and released. The scientist, on the other hand, must understand and appreciate what management is trying to do and must respond by giving full cooperation.

Key Questions for Research Managers

Despite a long and varied experience in managing, university, military and industrial research groups, the author confesses to a considerable ignorance on matters pertaining to research and the researcher. Some questions which trouble the writer, as a manager of research, and which, with others, may trouble other management officials should they conduct an audit and evaluation of their research facilities preparatory to designing goals and objectives for the future, are given below:

1. How does one measure the output, productivity or performance of a research organization? Is there a common yardstick, or can one be developed which can be used for various types of organizations? What is the nature of possible measures—profits, patents, pages—or can a more subtle and sophisticated measure be devised? Is one page of physics the equivalent of 1.7 pages of market research? Or should the yardstick as to the value of a research project be the pragmatic one, that the application shows up in the profit column?

2. How does one measure the output, productivity or performance of an individual researcher? Should this be done in terms of his contribution to the group? If so, how do we define contribution? Further, can researchers from different groups be compared and on what basis? If measures of performance are individual, and not in terms of contributions to the group, does this imply that organizations do nothing for the individual researcher? How and under what conditions can the individual's output on an incomplete but long-term project be assessed? Under what conditions can an individual's output or contribution be properly assessed in the near future? For example, were the magnitude of Newton's and Galileo's contributions appreciated in their day?

3. Given the difficulty of measuring performance, individual or collective, after the research has been carried out, how can we select people or design organizations who before the fact will be productive? What are the characteristics of people which are positively related to research productivity? Given that we know the positive characteristics, do we know how to identify the people with these characteristics?

4. Given the difficulties of performance measurement and of selection of research personnel, does it make sense to talk about "research climate"? What do we really know about the conditions conducive to research productivity? Do we need more people sitting under apple trees, more apples, or techniques for shaking apples down on people under apple trees? Do we need more research directors, air conditioning, or carpets on the floor?

5. Are the characteristics of researchers significantly different from those of any other relatively intelligent and literate group? For example, do researchers differ from others in their motives, their attitudes to profit, private enterprise, music, food, and sex? Should we not assume, until evidence is available, that they are just like

other people? Surely there is more evidence of similarity than of dissimilarity. They feed and reproduce like others of the species, although good researchers do not seem to breed good researchers, at least in great numbers. Are they not found in the most unlikely places?

6. Is the research team a device which generates effective research? Or, is its function that of making it difficult to tell who is responsible for failure to be productive? Can we assume that if one researcher produces an amount called x, that a team of researchers will produce x^n research or even x^{-n}? Is it not possible that the only productive work developed by the team will be the function of a single individual, and that this will be ignored or placed in disrepute by the team?

7. What are the objectives set forth for the research organization? What are the criteria by which to measure the performance of the research department? Patents, new products, new methods, profits, number of problems investigated? The percent of investigations brought to successful conclusion? The percent of studies which result in profitable applications? Does the research group clearly understand the corporate objectives? Are the company's objectives suitable for dynamic growth in the future?

8. Do the operating divisions view the research division as an overhead burden they must endure? Has good liaison been established between engineering, operations, and management? What criteria have been established for determining which projects should be supported? When they should be cut off? When they are sufficiently completed to be turned over to engineering or operations?

9. Does the company have a planned research program? If so, planned for what? For long-range technical developments? Short-term ad hoc operational studies? Have the qualifications of the staff been reviewed against the research objectives? Are steps being taken to upgrade the staff? Are there internal and external training courses? Does the company encourage publication of technical papers, attendance at meetings of professional societies, independent research, presentation of new and novel ideas? Is it a policy to hire more men for the laboratory or better men?

These are only a few of the questions to ask when reviewing and evaluating the research activity. That the problem of research management, direction, and planning is serious is shown by the widespread interest, at the levels of president and vice president of research, by growth companies in the electronic, aircraft, chemical, milling, food, oil, and mining fields. That this interest is more than casual is attested by the fact that the author's company is currently engaged in studying the research activity in one mining company and a major company in the oil industry. Another in the chemical industry, and still another in electronics have indicated they would like similar assistance. Thus, from the writer's own knowledge, there is evidence of both widespread interest and of intent to take action in the improvement and development of private industry research facilities in preparation for coming competition.

The mining industry is a fundamental element not only in the economic welfare of the country but also in its national defense. It is therefore mandatory that the rate of growth be accelerated, and this depends in no small part on an improved technology which in turn rests on more and better research.

RADIO COMMUNICATIONS

(Continued from page 50)

range. Because Class D Citizen Band radios are not limited to line-of-sight contacts, it became possible for individuals, professional people, small businesses and others to realize the unique advantages of radio telephone commnications without making a large initial investment.

Transceiver costs start at about $43 for an easily assembled kit with three controls (volume, channel tuner, and transmit-receive switch). Ready to use transceivers can be purchased for as little as $65, while deluxe units sell for as much as $200. Good serviceable whip antennas cost about $20 each. Beam antennas, for maximum range, are more expensive.

Factors Affecting Range

Small transceivers with a maximum allowable power input of five watts, which is about enough power to make a flashlight bulb glow, make communications possible over an area of 50 to 300 square miles. The distances over which effective communications between two Class D Citizens Band transceivers can be maintained depends upon transmitter power; antenna location, type, and height; nature of the terrain at and between the transmitter and receiver locations; frequency of operation; and atmospheric conditions.

Occasionally, as the result of ionosphere reflection, communications over distances of a few hundred to several thousand miles is experienced. Since the Citizens Radio Service is primarily intended for personal or business short-distance communication, this somewhat sporadic long distance communication is of interest only because of the occasional interference.

Users of Citizens Radio Service must accept interference not only from other Citizen Stations but sometimes from stations in other radio services. Because of the large number of contributing factors, it is difficult to define a meaningful communication range for any Citizen Band transceiver. Normally, expected ranges are five miles in any type terrain, ten miles in open countryside, and twenty miles using beamed antennas.

Class D Operating Frequencies

The FCC assigned 23 frequencies or "channels" to the Class D Citizens Band. These channels extend from 26.965 mc to 27.255 mc. The assigned frequencies are separated by more than the usual ten kilocycles at several points. This is due to the fact that Class C (radio control) has six channel assignments in this part of the radio frequency spectrum.

Because all Class D channels have been assigned on a shared basis with other stations in the Citizens Radio Service, it is important to remember that interference may be encountered on the 27.115 and 27.125 channels due to operation of industrial, scientific or medical devices on the frequency of 27.12 mc. Therefore, it would be advisable to refrain from utilizing these two channels unless the transceivers are located in remote areas.

Procedure To Obtain Licensing

Licensing is straightforward since there are no code tests, or examinations on radio theory, and no knowledge of specialized operating procedures is required. It is only necessary to fill out FCC Form 505, have it notarized, and mail it to the Federal Communications Commission in Washington, D. C. Most equipment suppliers furnish sufficient information to obtain a station license. It is required in the application that the applicant have in his possession a current copy of "Federal Communications, Part 19, Citizens Radio Service."

Any citizen of the United States over 18 years of age is eligible for a Citizens Radio license. The station units can be operated by any person regardless of age. The licensee, however, is responsible for the actions of the persons operating the licensee's units.

While the Citizens Band radio might be a valuable tool in the reader's operations, he is cautioned not to go on the air until he has received a license.

ANNUAL COAL DIVISION CONFERENCE

Use of Radioisotopes in Coal Industry discussed and Coal Division Committee reports given

RADIOISOTOPES IN THE COAL INDUSTRY

A conclusion quickly drawn from the Conference on "Radioisotopes in the Coal Industry" held November 17 in Pittsburgh is that radioisotopes already have made an impact on operations in the coal industry and promise additional and significant contributions as knowledge and ability to use radiation techniques grows in our industry. Atomic experts emphasized how radioisotopes are being used economically and safely by the coal industry and reported specific applications which could create greater profits for mine operators and coal equipment manufacturers alike.

It was made clear that the nation's industrial capability has been increased markedly by the application of new nuclear techniques through many facets of production, research and process control. As Paul C. Aebersold, director of the Office of Isotopes Development, U. S. Atomic Energy Commission noted: "Almost every area of our lives has already been touched by the effects of widespread radioisotope applications. The clothing we wear, the cigarettes we smoke, the automobile or airplane we ride in, the evening paper we read, and many other items in our daily experience have all been improved or more efficiently produced through safe, simple and routine industrial uses of radioisotopes."

Dr. Aebersold also reported that over 1700 major industrial organizations are using radioisotopes to carry out their manufacturing and research activities more easily, cheaply and quickly or to do jobs that heretofore were either impractical or impossible. It was encouraging to note that speakers from the nuclear instrument industry recognized that the coal industry has already learned the value of radioisotopes in mass flow measurement and as control tools in coal preparation plants.

While the conference noted the value of present nuclear applications in the coal industry, appropriate emphasis was placed on the future of expanded radiation techniques for increased sensitivity of measurement and for expanded productivity.

The challenging picture of the future was aptly and comprehensively reported in a survey completed for the Office of Isotopes Development, U. S. Atomic Energy Commission covering potential applications of radioisotopes to the mining, preparation, transportation, storage, handling and use of coal. The report* contained over 100 suggestions for uses of radioisotopes and noted that about 80 of the potential applications are reported to be in regular or experimental use somewhere in the world. For more than 35 suggested uses, examination revealed that present nuclear equipment was suitable for regular use, with some adaptations for specific cases. Nuclear devices were reported to be rugged, reliable and low in maintenance compared with many non-nuclear devices for similar uses.

Significantly, the discussions emphasized the safety aspects of radiation applications. The nuclear industry was quick to develop instrumentation with "safety" the prime engineering consideration. One AEC speaker reported that among the 140,000 workers in AEC laboratories and plants the injury rate was less than one-third of that reported by the National Safety Council as the average for all industries.

The importance of education and training to the expanded, profitable and safe use of radiation techniques was also emphasized. Informational resources are widespread and educational and training programs geared to assure the safe and intelligent use of radiation are being established throughout the industrial and educational communities.

A brief resume of the program follows:

The morning session was presided over by Jesse F. Core, vice president-operations-coal, U. S. Steel Corp., and chairman of the AMC Coal Division. J. R. Garvey, vice president and director, Bituminous Coal Research, Inc., was co-chairman. A. E. Seep, president, Mine and Smelter Supply Co., and chairman, AMC Manufacturers Division, presided at the afternoon session.

** POTENTIAL APPLICATIONS OF RADIOISOTOPES TO THE MINING, PREPARATION, TRANSPORTATION, STORAGE, HANDLING AND USE OF COAL: Final Report. Nov. 1, 1960. 233p. Contract AT (30-1)-2311. NYO-2859. Available from the Office of Technical Services, Department of Commerce, Washington 25, D. C., Price $3.00.*

Dr. Aebersold, the first speaker, described a radioisotope as an unstable atom, one that cannot exist indefinitely in nature. In breaking down, this unstable structure emits radiation—perhaps heavy, intensely ionizing but short range alpha particles; perhaps the light beta particle that can penetrate or be reflected from thin materials, and in most cases the very penetrating gamma rays. The great variety of radioisotope uses can be divided into three broad classes—1, tracer atoms, wherein their application is based on the detectability of very small amounts of radioisotopes; 2, measurement by radiation, that is, through radiography and use of a great variety of nuclear gauges in measuring thickness, or density and levels in process control; and 3, high-intensity radiation in which materials may have their properties altered, chemical reactions may be initiated or lab supplies sterilized.

Radioisotopes have had their greatest acceptance by the coal industry in coal preparation equipment controls, according to Charles O. Badgett, chemical industrial manager, Industrial Nucleonics Corp. Density controls are available that can measure down to plus or minus 0.003 specific gravity units, which can lead to the saving of over 13 percent of the coal commonly lost because of wider density fluctuations in manually controlled installations, Badgett stated. He also pointed out that a constant ash and moisture analysis system, using radioisotopes, has been marketed, and that these gauges represent a big step forward in complete automation of preparation plants.

Radiography in routine and preventive maintenance was discussed by A. J. Stevens, president, Radionics, Inc. The principle of gamma radiography is similar to that of X-radiography except that a small radioactive source replaces the X-ray machine. Gamma rays from a sealed source pass through the object being radiographed and impinge on a sheet of film. Upon developing the film, a shadowgraph is produced showing the condition and structure of the interior of the object. Radiography provides a nondestructive testing tool and is used primarily where there has been metal fusion—notably castings or weldments. It can also be used to examine complex assemblies for missing or misaligned parts.

Philip E. Ohmart, president, The Ohmart Corp., discussed the "Mass Flow Measurement of Coal in Motion." He pointed out that radioisotopes have been used to measure the density of slurries and that integrating this information with volume measurements provides a constant measure of tonnages being handled. It is also possible, he said, to accurately weigh coal on moving conveyors with nuclear gauges.

Portable, as well as on-line process control equipment which will measure moisture and density is available, reported O. Kenton Neville, vice president, Nuclear-Chicago Corp., in discussing density/moisture gauges in the coal industry. With portable equipment it is possible to measure the moisture and density of soil and of other related material at the earth's surface or down to 200 ft below the surface. In this way, overburden characteristics can be determined, or coal stockpiles can be more accurately measured for inventory purposes. He went on to say that continuous moisture gauges are now being successfully applied to anthracite and to coke. Certain problems exist, however, which limit their use in measuring moisture in bituminous coal at the present time. These problems are receiving study by several companies, and the long-range goal of nuclear instrument makers is a unit, or combination of units, which will provide a running analysis of moisture, ash and sulphur.

In summary, the conference took a hard look at new technological developments springing from the peaceful uses of atomic energy. It placed in perspective the industrial uses of new nuclear tools, the economics of radioisotope applications, and presented a practical approach to increased use of nuclear techniques throughout the coal industry.

REPORTS OF THE COAL DIVISION COMMITTEES

FRIDAY, November 18, saw the seven Coal Division Committees report on activities during the year to over 400 mine operators and equipment manufacturers.

Committee membership is made up of operating men and manufacturers vitally interested in each phase of coal mining. Committee work is carried on with the original objectives of the Coal Division in mind—to present the facts concerning modern mining methods and equipment to the industry without recommendation or bias. In addition to the Annual Conference, each committee meets two or more times a year. The primary purpose of these meetings is to disseminate information that is being gathered constantly by letter and personal contact.

LUNCHEON MEETING

Highlight of the Conference was the Coal Division Luncheon which was presided over by Jesse F. Core, chairman of the Coal Division. "The Office of Coal Research" was the subject of the luncheon address presented by Assistant Secretary of the Interior Royce A. Hardy. He told his audience that the Department of Interior expects the great majority of ideas for research projects to be investigated by the Office of Coal Research will originate outside the Office—mentioning that these would probably come from state mining bureaus, universities, nonprofit research organizations, research companies of coal companies and coal consumers, manufacturers of mining equipment, and industry trade organizations. He emphasized the Department's feeling that the greatest opportunity for short-range help would be in expanding the use of coal "in those areas where it is uniquely suited and in revealing and developing other such uses."

Hardy went on to delineate the relationship of the Bureau of Mines and the Office of Coal Research by stating that the work of the Bureau has always been confined to long-range fundamental laboratory and small pilot-plant research and development, and would continue in this field. He predicted that the results coming out of Bureau of Mines work may form starting points for projects that the Office of Coal Research undertakes.

On the following pages appear brief resumes of the reports presented at the conference.

COMMITTEE ON MINE SAFETY

Woods G. Talman, Chairman

Woods G. Talman, chairman, briefly reviewed the activities of the Committee on Mine Safety during 1960, explaining that its March meeting was devoted to the potential of hydraulic mining and its potential effect on mine safety, while the fall session concentrated on fire-resistant hydraulic fluids. He called on George Sall to summarize that meeting. Sall pointed out that the over-all impression gained at the meeting was that inverted emulsions have been improved considerably since they were first introduced, and that they are being used successfully in some mines. However, there appears to be a need for further improvement before they are completely accepted. After discussing the development of inverted emulsions, their effect on hydraulic systems, and their application in the field, he concluded that:

(1) Inverted emulsions do provide a fire-resistant hydraulic fluid, and they are being used successfully.

(2) That certain changes in the hydraulic system on a machine seem advisable, namely increasing the size of the suction line and eliminating any obstruction in the suction line. It would also seem to be a good idea to discuss the problem of readying a machine for conversion to inverted emulsions with the manufacturer of that machine.

(3) There is a problem of pump wear in vane and gear type pumps, but this is being overcome or minimized in newer models.

(4) The testing and evaluation of inverted fluids should continue with close cooperation between petroleum supplier, machine manufacturer and mine operator.

(5) Improvements have been made in inverted emulsions since their introduction and more can be anticipated.

(6) Any efforts to force the use of inverted emulsions should be resisted at this time.

COMMITTEE ON ROOF ACTION

Lonnie D. Ellison, Chairman

"The Cost of Roof Support" was discussed by E. H. Greenwald and D. C. McLean. Greenwald stated that the problem is strictly an engineering problem of measuring costs and that too many variables have to be taken into account to allow a direct comparison between total mining costs on two separate sections. He felt the approach should be one of determining mining costs on a section, arriving at a projected mining cost for the same section assuming improved roof, and comparing these two values to determine how much could be spent on better roof support.

McLean pointed out in evaluating the potential of any new method or system, the research man needs to know the value that can be gained by the introduction of such a method or system. He suggested that a quick measure of how much a company could spend on improving mine roof would be to compare production costs on a section having poor roof with one having good, or better, roof in the same mine. The difference, he felt, would be the amount a company would be economically justified in spending to improve the poor roof to the point that it was comparable to the good roof.

COMMITTEE ON STRIP MINING

E. R. Phelps, Chairman

J. J. Huey reported on the results of a survey of stripping machine capacities in 1959. The study covered 54 shovels and 25 draglines. The shovels represented 1875 cu yd of capacity and handled 77,495 yd per operating hour. The 25 draglines had a total capacity of 437 cu yd and moved 15,856 yd per operating hour. A pure arithmetic ratio shows that in 1959 the shovels reported on handled 41 cu yd per operating hour per yard of dipper capacity, the draglines 35 cu yd per yard of bucket capacity.

COMMITTEE ON COAL PREPARATION

J. J. Reilly, Chairman

The first report to be given was on froth flotation and was presented by W. C. McCulloch, chairman of the subcommittee on fine coal preparation. Pointing out that froth flotation can be economical in plants of any size, he said that its prime use is to upgrade coal fines but that it is also a valuable tool in water clarification, while permitting the recovery of coal previously lost. The report also discussed a common problem in froth flotation circuits — the bottleneck caused by filtering and the breaking of froth. Other topics covered included flocculation, filtration and drying.

P. W. Bigley, chairman of the subcommittee on coal drying, discussed thermal drying practice at several coal preparation plants. Operations described ranged from one at which two fluid bed type units are drying three sizes of coal—1 by 5/16 in., 5/16 by 10 mesh, and 10 mesh by 0—to one employing a reciprocating deck type of drier designed to handle 270 tph, but which has been pushed up to 400 tph.

E. R. Palowitch was called on to briefly spell out the progress being made by the U. S. Bureau of Mines in its study of the Performance Characteristics of Coal Washing Equipment. The over-all purpose of this study is twofold: (1) The establishment of a practical standard of efficiency by means of which coal operators may assess their day-to-day operating performance, and (2) the compilation of practical operating data to aid in a more scientific selection of coal washing equipment commensurate with the characteristics of the raw coal that must be washed and the desired end products that must be produced. Palowitch said that the Bureau is currently studying concentrating tables washing raw, resultant fine coals. Several plants have already been sampled, and more are scheduled. He believes that the report on the performance of tables should be published next summer.

COMMITTEE ON MINE POWER

James A. Erskine, Chairman

Following lunch the Committee on Mechanical Mining made its report. After a brief review of the year's activities by James A. Erskine, chairman, a progress report on the Power Committee's study of trailing cable failures was given by R. S. James. Believing that trailing cable life can be improved, the committee has launched a campaign to better cable performance. A brief detailed questionnaire is being used to obtain cable service records in underground mines. These data will be used to determine various yardsticks of cable performance. The primary objective is to draw some helpful conclusions on present cable performance.

"Training A-C Equipment Maintenance Personnel" was the title of the next report, which was presented by Frank Hugus, chairman of this subcommittee. This subcommittee has been gathering information on how individual coal companies are training maintenance personnel, especially in the maintenance of a-c equipment. Several companies have set up train-

ing classes and purchased or built demonstration patterns. Some have hired instructors from outside the company and others use a company man. In some areas the electric utility serving the particular area has conducted courses. Equipment manufacturers have handbooks and maintenance manuals available and several present maintenance programs before interested groups. Various universities and vocational schools offer extension courses on a-c. Hugus noted that (1) some sort of incentive is needed to make men take courses on their own time, and (2) in training classes, a "buddy" system works well . . . one man creates a fault in a particular piece of equipment, or on the test panel, and his partner then tries to find and correct the fault.

As the final part of the Power Committee's part of the program, a tentative standard of electrical symbols for coal mining was presented. This will receive concentrated study during 1961, in the hopes that a standard can be adopted by the next Coal Division Conference.

COMMITTEE ON MECHANICAL MINING

James A. Younkins, Chairman

Arnold Condon, chairman of the subcommittee on Ventilation for Methane Dilution, discussed the work of this group. In outlining the present practice in ventilating continuous mining sections to dilute methane, he said from 35 to 40 companies are using some method of auxiliary ventilation. Full consideration was given to the use of auxiliary fans—both blowing and exhausting—and the practice of employing a small blower fan mounted on the continuous mining machine to blast the air with a high velocity stream of air to disperse and dilute the gas inby the cutting head of the machine when it is operating. He complimented the U. S. Bureau of Mines on its cooperation with the industry to help solve the problems that have been encountered.

The report on "Ventilation for Dust Control" was given by George Alston, chairman of this subcommittee. He pointed out the rising interest in dust control for hygienic purposes, and commented on some of the problems involved in removing or collecting dust with an exhaust system.

The final report of the Committee on Mechanical Mining had to do with "Aptitude and Achievement Testing." John E. Osmanski made the presentation. The purpose of this subcommittee is to establish the validity of aptitude and achievement tests which might be used in the coal industry, and to determine standards to measure tests against. The group is focusing its attention right now on continuous mining machine operators. Five companies are cooperating with the subcommittee in a project to compare scores of three types of tests—Mechanical Comprehension, Paper Form Board and a Two-Hand Coordination Test—with the performance evaluation of some 150 operators to determine the validity of the tests in predicting operator performance. The correlation of operator performance and personal statistics such as height, weight and age will also be studied. The subcommittee's ultimate objective is to have an industry-wide battery of tests that will, for any company, under any conditions, select or predict the performance of any individual in a particular job.

The Annual Coal Division Luncheon featured an address on "The Office of Coal Research," by Assistant Secretary of the Interior Royce A. Hardy

COMMITTEE ON MINE HAULAGE

A. G. Gossard, Chairman

Arnold Asman discussed recent trends in conveyor design, saying that the impetus for changes in design come from the users of conveyors. Pointing out that sales of mine conveyors in a single year approximate 100 miles he noted that the average width today is 36 in. and that rope side frame conveyors account for about 85 percent of all mine applications. Belt speeds are being increased to take care of higher momentary feed rates, with 600 fpm common on mainline units. There is also a trend to deep trough idlers, with 35° being the optimum. The effect of going from a 20° to a 35° idler is the same as substituting a 36 for a 30-in. belt. Head sections are more compact than they used to be and idler diameters are increasing. He said that the tendency now is to buy conveyor components "off the shelf" and work them into a custom installation. In touching on good conveyor haulage practice, he recommended against reversing belts and recommended open transition chutes at all transfer points.

Final report of the day was given by John Adams on "Trends in Rail Haulage."

Pointing out that you can't efficiently gear up an outmoded track haulage system, Adams said that some progressive coal companies had revolutionized their track haulage system. One company has reported a 29 percent increase in production with this approach. He said that good track haulage depended on good design and attention to details. To reduce trip rolling friction some operators are using air or water jets to remove sand from the rails after the locomotive has had the benefit of the sand; others are using flange lubricating devices at critical points; live load ratios of as high as 3 and 4 to 1 are being attained, and mine cars are getting larger while trip speeds are increasing.

Stressing the value of on-the-job-analysis of all factors contributing to haulage costs, including construction, Adams said automatic tie tamping has increased efficiency 250 percent over hand tamping and that automatic tie spiking machines, now being used by the railroads, promise results that are just as dramatic. Standardized track laying procedure has reduced track installation costs at some mines and increasing tie centers from 21-in. to 24-in. has saved 320 ties per mine with little sacrifice in track strength at another.

As Viewed by HENRY I. DWORSHAK of the American Mining Congress

IN compliance with the 20th amendment to the Constitution of the United States, the 87th Congress convened at noon January 3. Its membership, not materially changed from that of the previous Congress, is as follows: Senate—65 Democrats and 35 Republicans: House—262 Democrats and 175 Republicans.

The new Congress was expected to conduct little legislative business other than introduction of bills until inauguration January 20 of the new President, Democrat John F. Kennedy of Massachusetts. In the meantime, President Eisenhower was scheduled to deliver his final State of the Union message and submit his proposed Federal budget for the fiscal year beginning next June 30.

COMMISSION RELEASES REPORT ON IRON ORE IMPORTS

After a thorough study, the Tariff Commission announced December 30 that increased imports of iron ore are not causing or threatening to cause serious injury to domestic iron-ore producers. The Commission's investigation was requested last June 30 by the Senate Finance Committee.

In its report, the Commission noted that U. S. iron and steel producers turned to foreign ore supplies to supplement domestic ore production for these reasons: "(1) The growing need for economic supplies of high-quality iron ore, (2) the marked depletion of the most economic high-grade ore deposits in the traditional domestic producing centers during World War II, (3) the installation of much new iron and steel-producing capacity at centers conveniently located at ocean ports to which foreign ores can be economically transported by water, and (4) the development of the St. Lawrence Seaway, which made the iron and steel facilities along the Great Lakes more accessible to iron ores from Canada and, to a lesser extent, from other foreign sources."

Imports of iron ore have been entered free of duty since 1913, and their duty-free status has been "bound," or confirmed, in various international trade agreements dating back to 1944. The Trade Agreements Act provides that if the Tariff Commission had found these "bindings" injurious to the domestic iron-ore industry, it must recommend that the President take corrective measures, which could include "the establishment of import quotas, to the extent and for the time necessary to prevent or remedy such injury."

Because it found that the domestic industry was not being injured, the Commission made no recommendations.

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Washington Highlights

CONGRESS: Convenes January 3

IRON ORE: Tariff Commission releases import study

RESIDUAL OIL: Higher year-end imports permitted

MINERAL PRODUCTION: Near-record set in 1960

DISTRESSED AREAS: Report urges Federal action

SILVER: Treasury to continue industrial sales

WATER POLLUTION: Greater Federal control urged

★ ★ ★ ★ ★ ★

FOURTH QUARTER IMPORTS OF RESIDUAL OIL HIKED

At mid-December the Interior Department announced that it had raised the residual oil import quota for the October-December quarter from an average daily allocation of 415,000 barrels to 458,478 barrels, thus permitting an additional 4 million barrels to be supplied to consumers during the last two weeks of 1960.

According to the Department, the adjustment was made to meet increased requirements resulting from severe weather on the Eastern Seaboard. The Department added that it "has repeatedly assured consumers of residual fuel oil that there is no intention to administer the [import control] program in such a manner as to bring about artificial shortages with consequent hardship to normal users. To this end the program is subject to a continuing review."

In November the Interior Department announced that the residual import allocation for the first quarter of 1961 would be 530,000 barrels daily. This is 130,000 barrels per day less than the 660,000-barrels-per-day allocation for the first quarter of 1960.

U. S. MINERAL PRODUCTION RISES IN 1960

Value of the Nation's mineral production in 1960 was $17.8 billion, 4 percent above 1959 and second only to the record high of $18.1 billion in 1957, the U. S. Bureau of Mines estimated in a year-end announcement.

The agency's preliminary figures listed the value of 1960 production as follows: Oil, gas and coal, $12,183,000,000, up slightly from 1959; nonmetallics, $3,633,000,000, down somewhat from the previous year; and metals, $2,012,000,000, up sharply.

Those metals whose output was affected by strikes in the last half of 1959 and the first quarter of 1960—copper, iron, vanadium, and tungsten—reported increases ranging from 30 to 40 percent for 1960, the Bureau reported, thus counterbalancing declines in lead, zinc, silver, manganese, rare earths, and thorium. Uranium production increased from $141 million in 1959 to $156 million in 1960, and small increases were registered by gold and platinum.

Bituminous coal and lignite output in 1960, estimated at 415 million

tons, was up 0.7 percent from the 412 million tons produced in 1959.

DEPRESSED AREAS REPORT RELEASED BY KENNEDY

Early this month President-elect Kennedy made public the report of a task force he had appointed to propose solutions to the problems of depressed areas. The 22-member group was headed by Senator Douglas (Dem., Ill.).

The group's report said there is "wide bipartisan agreement that the distressed area problem cannot be resolved by private initiative alone" and recommended "a diversity of programs" for immediate and longer-range Federal action to alleviate the problem.

Recommendations of the task force were in two categories: (1) The relief of personal hardship; and (2) the development of long-term job opportunities. With respect to the second category, the report said the most immediate need is for legislation which will encourage new industries to locate, and existing industry to expand, in industrial areas of chronic unemployment and in underdeveloped rural and small urban areas of underemployment.

The report also recommended acceleration of Government research on minerals and coal, and development of a National Fuels Policy. It added: "A National Fuels Policy would help alleviate prevalent distress, would help improve the economic health of these industries, and would be beneficial to the Nation's security."

TREASURY REJECTS PLEA TO END SILVER SALES

The U. S. Treasury believes that it "should continue to sell silver for industrial uses when requested" even though its supplies of the metal not earmarked for monetary use are dwindling, Assistant Secretary Robbins has advised Senator Dworshak (Rep., Idaho).

In a letter to Treasury Secretary Anderson last month, the Idaho Senator urged termination of industrial sales to safeguard silver reserves. "Higher prices for silver, especially when produced as a by-product of lead, zinc, and copper, would greatly strengthen this industry and provide much needed employment for miners," his letter said.

Replying for the Treasury Department, Robbins said: "I cannot understand how this would strengthen the copper, lead and zinc industry, inasmuch as the production of those metals at the present time appears to be sufficient to balance demand and any further production would have an unstabilizing effect on the price of the base metals."

Robbins also stated that foreign producers supply 65 percent of industrial demand for silver and thus would get the the major benefit of any price increase. "This would affect the balance of payments problem," Robbins wrote, "inasmuch as the price for silver would increase the dollars that foreigners earn and such dollars do become potential claims against our gold supply."

GREATER FEDERAL CONTROL OF WATER POLLUTION URGED

Secretary Flemming of the Department of Health, Education, and Welfare has recommended several measures to give the Federal Government greater authority in abatement of water pollution, including extension of Federal jurisdiction to all navigable interstate streams whether or not pollution in any one State is affecting people in another State.

Flemming, who will soon be succeeded as Secretary by Governor Ribicoff of Connecticut, made his recommendations at a National Conference on Water Pollution held in Washington last month.

The Secretary also recommended expansion of the definition of interstate waters to include coastal waters and all waters which flow across or form a part of State boundaries; enactment of legislation authorizing the Department to issue orders for pollution abatement; more financial and technical aid to State and interstate agencies; expansion of activities related to comprehensive planning for water pollution control; and encouragement of interstate water pollution control compacts.

A contrary view was taken by James Hyslop, president of Hanna Coal Co. He pointed out that significant progress has already been accomplished in the field of abatement of stream pollution caused by industrial waste and that the Ohio River Valley Water Sanitation Commission, an interstate agency, has made "solid accomplishments" in cleaning up the water of the Ohio River Basin and in the difficult field of State, interstate, and Federal relationships in the abatement program.

"In view of these accomplishments," Hyslop said, "we submit that any extension of Federal legal or police authority in the field of stream pollution would at this time of accomplishment and progress be a serious and expensive mistake."

THE REPORT CORNER

Recent Publications of Interest to Mining Men

"Gold and Money Session," a 60-page booklet, consisting of the papers and statements of eight prominent authorities on gold, and monetary policies, who participated in the Gold and Money Session at the 1960 Pacific Northwest Metals and Minerals Conference, is available at $1.50 per copy from State of Oregon Department of Geology and Mineral Industries, 1069 State Office Bldg., Portland, Ore. Make checks payable to Pacific Northwest Metals and Minerals Conference.

Circular 302, "Lower Pennsylvanian Clay Resources of Knox County, Illinois," by Walter E. Parham. Illinois State Geological Survey, Urbana, Ill.

"Historical Statistics of Minerals in the United States." Compiled and annotated by Sam H. Schurr with the assistance of Elizabeth K. Vogely. Resources for the Future, Inc., 1775 Massachusetts Ave., N. W., Washington 6, D. C. Price $1.00.

U.S.B.M. Information Circular 7971, "Iron Mining Methods and Costs, Greenwood Mine, Ishpeming, Mich.," by R. C. Annear and W. A. Cole. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price 30 cents.

Reprint from U.S.B.M. **Minerals Yearbook, 1959,** "Coal—Bituminous and Lignite," by W. H. Young, R. L. Anderson, and F. M. Hall. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price 30 cents.

U.S.B.M. Information Circular 7956, "Mining Methods and Costs at Crystal-Victory and Minerva No. 1 Fluorspar Mines of Minerva Oil Co., Hardin County, Ill.," by Gill Montgomery, J. J. Daly, and Frank J. Myslinski. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price 50 cents.

U.S.B.M. Information Circular 7987, "Injury Experience in Coal Mining, 1957," by John C. Machisak, Virginia E. Wrenn, Nina L. Jones, Elizabeth J. Reid, and Dora D. Rice. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price 45 cents.

Bulletin 16, "Mines and Mineral Deposits (Except Fuels), Jefferson County, Montana," by R. N. Roby, W. C. Ackerman, F. B. Fulkerson, and F. A. Crowley. Montana Bureau of Mines & Geology, Room 203-B, Main Hall, Montana School of Mines, Butte, Mont. Price $1.75.

personals

Fred S. Mulock, president. and **Neil W. Rice,** chairman of the board, United States Smelting Refining & Mining Co., have retired. **Charles G. Rice,** formerly executive vice president, succeeds Mulock, but a successor to Neil W. Rice has not been named. Both retiring officers will continue as directors of the company.


F. S. Mulock

The retiring president, Mulock, has been with U. S. Smelting since 1920. Previously, he was employed by the U. S. Bureau of Mines and had also been an electrical engineering instructor at Stanford University. He became president of the company in 1950. Mulock is a director of the American Mining Congress.

Other executive changes in the company include the promotion of **J. George Gange** from administrative vice president to senior vice president, and **John B. Metcalfe** from assistant to the president to vice president. **Sidney W. Winslow,** who has been a director for 49 years, is also retiring.

C. R. Griffith, president, Southern Coal & Coke Co., was recently reelected president of the Southern Appalachian Coal Operators' Association. **Fred Loving, Jr.,** general manager of Kentucky Ridge Coal Co. was elected first vice president.

Eastern Gas & Fuel Associates announces three changes in the assignment of superintendents in southern West Virginia mines. **Donald B. Shupe,** formerly superintendent of Wharton No. 2 mine, has been transferred and will now be superintendent of the company's Kopperston mine. **Robert H. Freeman,** formerly superintendent of Wharton No. 1 mine, succeeds Shupe at Wharton No. 2. **Wayne M. Plymale, Jr.,** formerly superintendent of Eastern's Beards Fork mine, which was closed recently, becomes superintendent of Wharton No. 1.

Three executive appointments have been announced by Southern Peru Copper Corp. **Edward McL. Tittmann** has been appointed president. He will have his headquarters in New York, and will continue as chairman of the executive committee. **F. W. Archibald** has been named vice president and general manager of all the corporation's operations in Peru. Archibald will be stationed at Toquepala, site of the company's open pit copper mine, mill and smelter. **D. J. Buckwalter** has been appointed smelter superintendent.

New officers of the Hazard Coal Operators Association include **Joseph M. Richards,** general manager of Blue Diamond Coal Co., president, and **C. E. Fannin,** general manager of Carrs Fork Coal Co., vice president. Richards, as president of the Association succeeds **Finley H. Davis,** president, Midland Mining Co., who continues as a director.

Nels W. Stalheim, chairman of Federal Resources Corp., has been elected president of Col-U-Mex Uranium Corp. Federal recently acquired controlling interest of Col-U-Mex.

Charles A. Steen has been elected vice president, exploration and development, Standard Metals Corp. He succeeds **Aaron Holzman,** who will continue on Standard's board of directors. Steen is president of Utex Exploration Co.

H. F. Yancey, chief of the Seattle Coal Research Laboratory of the U. S. Bureau of Mines, has retired after 43 years of Government service. He has been succeeded by **Max R. Geer,** assistant chief of the Seattle laboratory. Yancey holds the Perry Nichols Award of AIME for "notable achievement in the field of solid fuels" and has received the Distinguished Service Award of the Department of the Interior.

J. Guy LaVergne, production manager of phosphate operations at Bartow, Fla., for International Minerals & Chemical Corp., was recently promoted to manager - operations planning in the Agricultural Chemicals Division - Production at Skokie, Ill. **Sherman A. White,** formerly a consulting engineer with International Nickel Co., succeeds LaVergne at Bartow.

George W. Land has been appointed director of engineering services for Walter Bledsoe & Co. Land has had 20 years of varied experience in the bituminous coal industry including research, combustion engineering and consulting. In his new post, he will be in charge of combustion engineering services and will serve as a consultant to the company on coal preparation matters.

Richard L. Ash has joined Missouri School of Mines & Metallurgy as assistant professor of mining engineering. He was formerly a technical representative in the explosives division, Atlas Powder Co.

John K. Gustafson, vice president-geology and development, Hanna Mining Co., has been named to succeed **Donald H. McLaughlin** as president of Homestake Mining Co.


J. K. Gustafson


D. H. McLaughlin

McLaughlin, who will become chairman of the board "for about a year," will continue as chief executive officer. McLaughlin has been president of Homestake since 1945, prior to which he was general manager of Cerro de Pasco Corp. He has, however, been associated with Homestake since 1926.

Gustafson has been in the mining industry since 1930. In 1947, he was appointed director of raw materials of the Atomic Energy Commission. He joined Hanna Mining in 1949 as vice president-geology and development.

Frank A. Forward, head of the Department of Metallurgy, University of British Columbia, has been awarded one of the 1960 John Scott Awards of the City of Philadelphia for his invention of the Forward process for extracting nickel and other metals from ore concentrates. Past recipients of the award, which was established in 1816 by John Scott, a chemist, have included Marie Curie, discoverer of radium, Orville Wright, aviation pioneer, and Guglielmo Marconi, inventor of the wireless telegraph.

Clarence H. Sleeman has joined Koppers Co. as chief mining engineer for the Foreign Department in the Engineering and Construction Division. He will work primarily on the development of the El Algarrobo iron ore deposit of Compania del Acero del Pacifico, S. A., in Chile. Sleeman was formerly chief mining and development engineer for the Ore Mines & Quarries Division, Jones & Laughlin Steel Corp.

George F. McKereghan has joined Mine Management Associates, Ltd., as chief engineer in the development of a new open pit iron mine in Liberia. Mine Management is agent for National Iron Ore Co., Ltd., of Monrovia, Liberia. McKereghan had been special assistant to the president, Calumet Division, Calumet & Hecla, Inc.

Adolph V. Mitterer recently joined Leslie Salt Co. as manager of operations at Amboy, Calif. He had previously been a mining engineer in the Mining & Exploration Dept., International Minerals & Chemical Corp.

Rush M. Muse, formerly pit operations superintendent, Nevada Mines Division, Kennecott Copper Corp., has been named mines plant general superintendent at Ruth. Muse has been succeeded by **J. D. McBeth** who was previously shovel general foreman. **Dale J. Brown** has assumed McBeth's previous duties.

Warren H. Hinks, Jr., mining standards consultant of Johnstown, Pa., and **Victor L. Hurley,** mine operator and management consultant of Charleston, W. Va., have announced their association under the name of Hurley & Hinks, mining production consultants specializing in mine production surveys, equipment studies, mine management, time studies, cost control systems, standards installations, and foreman training.

Robert D. Hutchinson has been named Northwest District geologist, Bear Creek Mining Co. Prior to joining the Kennecott subsidiary, he had served with the Geological Survey of Canada, Union Carbide Ore Co., and Kennco Exploration, Ltd.

Leon E. Battles, supervisor of mining engineering with Oliver Iron Mining Division of U. S. Steel Corp., has retired after 42 years of service.

Joseph M. Word has been named chief inspector of ore mines and quarries, Tennessee Coal & Iron Division, U. S. Steel Corp. He succeeds **Forrest R. Birchfield,** who retired recently after 37 years service with the division.

George W. Streepey has been elected vice president in charge of the raw materials and refining divisions, Aluminum Co. of America. He was previously assistant production manager, being named to that position in April 1960.

OBITUARIES

George S. McCaa, 76, widely known pioneer in mine safety, died November 28 in Pittsburgh.

Mr. McCaa, who invented the McCaa two-hour self-contained rescue breathing apparatus, was with the U. S. Bureau of Mines for 14 years before becoming a state mine inspector in Pennsylvania, in which position he served for 30 years until retiring in 1958. He was a former president of the Coal Mining Institute of America and a founder of the National Mine Rescue Association.

Edward P. Scallon, 77, consultant and former assistant to the president, Butler Brothers, died in St. Paul, Minn., November 19.

Mr. Scallon's career in the mining industry, which spanned 48 years, began on the iron ranges of Minnesota. From 1918 to 1930, he was superintendent for Clement K. Quinn Ore Co., and for the seven subsequent years was a consultant. From 1937 to 1948, he served as assistant to the president of Butler Brothers and thereafter was a private consultant and consultant to M. A. Hanna Co.

Nelson P. Jackson, 49, director of Government relations for Joy Manufacturing Company's offices in Washington, D. C., and **Roger F. Bell,** 23, an employe of Joy, were killed November 13 in a light plane crash near Elkins, W. Va., while enroute from Oxon Hill, Md. to the Joy plant at New Philadelphia, Ohio.

Hayden F. Sears, 48, superintendent of Erie Mining Company's mining department, died November 19 in Hoyt Lakes, Minn. Mr. Sears joined Pickands Mather & Co. in 1936 and was employed on the Cuyuna range for about 20 years until transferred to Erie's Hoyt Lakes operations in 1956.

Sherman Eigle Burt, 51, director of member services of the National Coal Association, died December 5, while vacationing in Bermuda.

Mr. Burt, who was well known in the bituminous coal industry and in legal and governmental circles, was general counsel of American Coal Sales Association for eight years until it merged with the National Coal Association in 1960. He was past chairman of the coal committee of the American Bar Association's section on mineral and natural resources law. He had been associated with the mining industry for 27 years.

Perry S. McCallen, 68, retired president of Sanford-Day Iron Works, Inc., died in Knoxville, Tenn., November 20, 1960. Mr. McCallen joined Sanford-Day in 1920 and became president of the company in 1946. He retired in 1954.

Bert S. Butler, 83, retired professor and head of the Department of Geology and Mineralogy at the University of Arizona, died in Tucson, Ariz., November 13.

Dr. Butler joined the University of Arizona in 1928 after 20 years of service with the U. S. Geological Survey and Calumet & Hecla Consolidated Copper Co., now Calumet & Hecla, Inc. In addition to other honors received over the years, Dr. Butler received the University's 75th anniversary Medallion of Merit in 1959 in recognition of his services to the institution, the State and the Nation.

NEWS and views

Eastern

Seaton Appoints Coal Research Group

Secretary of the Interior, Fred A. Seaton, recently appointed 14 representatives from various segments of the Nation's coal industry to be members of a general technical advisory committee for the Department's Office of Coal Research. This office was authorized by Public Law 86-599 and approved by President Eisenhower last July. The committee will exercise consultative functions in connection with administration of the Act and will assist in evaluation of research projects.

The Office of Coal Research will contract for, sponsor, cosponsor, and coordinate research to develop new and more effective uses for coal, to expand present coal uses, and to reduce the cost of coal production and distribution. It will concentrate on short-range research projects aimed at providing the most immediate economic assistance to the coal industry as contrasted with the longer-term research programs of the U. S. Bureau of Mines.

Members of the committee that were appointed for a two-year term are: G. A. Shoemaker, president of Consolidation Coal Co.; Harry LaViers, president of South-East Coal Co.; R. E. Salvati, president of Island Creek Coal Co.; F. S. Elfred, chairman of the board, Peabody Coal Co.; Philip Sporn, president of American Electric Power Co.; Michael F. Widman, Jr., director of Marketing and Research, United Mine Workers of America; S. T. Saunders, president of the Norfolk & Western Railway; H. B. Charmbury, head, Department of Mineral Preparation, Pennsylvania State University; G. R. Spindler, dean, School of Mines, West Virginia University; Walter K. Scherer, president of Fred Scherer, Inc.; J. D. Jillson, president, Anthracite Institute, Inc.; Maurice H. Bigelow, technical director, Allied Chemical Co., Plastics and Coal Division; Samuel Lenher, vice president, Research and Development, E. I. duPont de Nemours, Inc., and W. L. Wearly, president of Joy Manufacturing Co. Samuel G. Lasky, Staff Assistant for Minerals, Office of the Secretary of the Interior, was named temporary head of the Office of Coal Research.

International Symposium on Mining Research

The University of Missouri School of Mines & Metallurgy at Rolla and the U. S. Bureau of Mines will hold an International Symposium on Mining Research at the University February 22 to 25. The sixth in a series of symposia on mining research, it will include the research categories of explosives and blasting, rock mechanics and basic research applied to mining.

This Scotch pine was grown on reforested strip-mined land. The American Mining Congress owes a vote of thanks to the Ohio Reclamation Association—and especially to its executive vice president, Larry Cook—for the beautiful Christmas tree it had last month. The association annually plants 3,000,000 trees, including a variety of pine and hardwood species, on strip-mined land

Authors from Austria, Australia, Canada, Czechoslovakia, England, France, Germany, Japan, Sweden and the United States have responded to invitations to present papers, and arrangements are being made to have all presentations given in three languages—English, German and French—by means of wireless translation equipment with individual earphones.

1500 TPD Coal Mine Opened

On November 1, Baton Coal Co. started operations at its new Mahoning Creek mine which is being operated by Carpentertown Coal & Coke Co. Located at Templeton, Pa., the operation is designed to load 1500 tpd. The preparation plant prepares 180 tph of metallurgical coking coal which contains 80 percent of minus 1/8 in. Facilities include a dense media washer and tables.

Baton has also constructed 264 beehive ovens and, in conjunction with this, has installed crushing and screening equipment which permits the loading of three sizes of coke. The coke is primarily for the blast furnace business with the smaller sizes being offered to the commercial market.

ALSO . . .

Freeport Sulphur Co. has placed in operation a new sulphur mine at Lake Pelto about 60 miles southwest of New Orleans. To mine the deposit, the company is using its barge-mounted plant, employed originally at the now-depleted Bay Ste. Elaine deposit.

A new program of cooperative geologic mapping by the State of Kentucky and the U. S. Geological Survey is planned to cover the entire state within about ten years at an approximate cost of $12,000,000. It is anticipated that as many as 70

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geologists will be assigned to geologic mapping of Kentucky during the peak years of activity. The project depends upon the availability of appropriations on both the State and the National levels.

The Sixth Annual Appalachian Underground Corrosion Short Course will be held June 6, 7, and 8 at West Virginia University, School of Mines, Morgantown, W. Va. The course covers basic, intermediate and advanced education of corrosion control practices as related to underground pipe, cable and water systems. Additional information regarding the course can be obtained by contacting John H. Alm, Publicity Chairman, Dearborn Chemical Co., 2 Gateway Center, Pittsburgh 22, Pa.

Kaiser Aluminum & Chemical Corp. plans to build a $700,000 plant to produce active alumina having a uniform spherical shape at its Baton Rouge alumina works in Louisiana. Completion is anticipated for the second quarter of 1961. The plant will increase the corporation's capacity for producing active alumina by five-fold.

Armour & Co. will spend some $60,000,000 for expansion of the Armour Agricultural Chemical Co. Division. New facilities, which will triple production of phosphates and nitrogen by 1962, account for the major portion of the program. The nitrogen plant will be located at Sheffield, Ala., and the phosphate operation will be in Polk County, Fla.

EN&V ALSO . . .

Super strong steel, free of any imperfections and tailor made to specific jobs, may be the next major development in the steel industry, according to Dr. William A. Pennington, president of American Society for Metals. He said that metallurgists are striving to develop methods for eliminating completely the imperfections that reduce the strength of a metal, steel as well as others. He noted that General Electric Company's recent laboratory-produced high purity iron "whiskers" had a tensile strength of 5,000,000 psi, 100 times the strength of ordinary iron. However, he added, we haven't learned yet how to produce perfect iron or steel in sizes large enough for practical use. When the metalurgical industry does, he said, the development will constitute a major breakthrough.

Marquette Cement Mfg. Co. is speeding work on modernization of its Superior, Ohio, plant. When the current rebuilding program is completed by mid-year, the plant will be modern throughout, and will have a production capacity of 1,500,000 bbl annually.

An 80-ton portable coal tipple capable of processing coal at the rate of eight tpm has been in operation in Jackson County, Ohio, for several months. Ura Swisher, owner and operator of Swisher Coal Co., Gallipolis, designed and built the tipple from a flat bottom railroad gondola car. The rubber-tired plant has a diesel powered unit which provides 150 kw of power for nine electric motors which operate the tipple's elevators, vibrator screen and crusher. The entire machine while in operation can hold as much as 90 tons, including a full 20-ton storage bin from which coal is loaded into trucks. It has processed as much as 2200 tpd of coal which is hauled to Gallipolis and shipped on barges to Ohio River electric plants.

The Pennsylvania Railroad has placed orders for 3500 new freight cars with delivery beginning this month. The order includes 2500 hopper cars for hauling coal and 1000 short heavy-duty "jennies" for iron ore. They will be constructed at Pennsy's shop near Altoona, Pa., and are scheduled to be in service by September of this year.

Granite City Steel Co. recently awarded a contract to Koppers Co., Inc., to design and construct a battery of 61 Koppers-Becker coke ovens and coal-chemical facilities for its Granite City, Ill., plant.

Allegheny River Mining Co., Kittanning, Pa., is preparing to open its new Cadogan No. 2 mine in Armstrong County. In order to tap a reserve of more than 25,000,000 tons of Lower Kittanning coal, the company had to drive through a fault approximately 3500 ft wide. The main headings are now through the fault and the company is in the process of turning and driving several production headings. The operation is expected to be capable of producing 2000 tpd in the early months of this year.

The Norfolk & Western Railway will expand its coal shipping facilities at Lamberts Point, Norfolk, Va., with the construction of a new pier to cost approximately $19,000,000. The pier, which is expected to be completed in two years, will bring N&W's Lamberts Point coal dumping capacity to 1800 cars per day in peak periods.

NEWS and views

Western

Major Molybdenum Find Reported

Exploration work at the Questa, N. M., mine of Molybdenum Corp. of America has revealed the existence of a molybdenum deposit termed by company officials as being of major significance. The Questa mine ceased operations in 1956 after having produced about 20,000,000 lb of molybdenum disulphide during the preceding 33 years. During the three years ending in June 1960, the company explored the Questa properties for molybdenum with the assistance of a Defense Minerals Exploration Administration loan. This work, which consisted largely of drifting and diamond drilling, disclosed a 260 million ton deposit of mineralization from which assay samples show about a 0.15 percent molybdenum content. Additional exploration since June 1960 has extended the zone of mineralization and further drifting and drilling is contemplated in order to define two enriched zones. When exploratory work in the enriched zones is concluded, the company expects to decide whether or not mining of the deposits is warranted.

To Install Skip Hoist at Chino

A $2,350,000 contract has been awarded for construction of a skip hoist system at the Chino Mines Division open pit copper mine of Kennecott Copper Corp., Santa Rita, N. M. According to company officials, it will be the largest such system ever built. It will consist primarily of two 40-ton skips operating on a 1400-ft inclined track and capable of moving in excess of 1000 tph. The system is designed for operation by two men.

Ground preparation, which is already underway, includes excavating a 45-ft wide slot from the top of the pit to the bottom. The skips will work in counterbalance on a 12-ft wide track inclined about 30°. Skips will be filled from a 40-ton bin serviced by 40-ton capacity trucks at the pit bottom and will dump automatically at either a 1000-ton ore bin or a 350-ton waste bin at the top.

Installation of the skip system will eliminate some of the present rail haulage in lower levels of the pit, but trains will still be used extensively in upper areas, and for ore haulage to the mill and smelter at Hurley, and waste haulage to nearby dumps. Work on the project is expected to be completed in September.

New Perlite Milling Operation

Johns-Manville Corp. has placed its new 150,000 ton per year perlite processing mill at No Agua, N. M., in operation. The new mill, which cost

(Continued on next page)

1961 AMC MINING CONVENTION

Scheduled for Seattle, September 10-14

Robert M. Hardy, Jr., president of Sunshine Mining Co. and chairman of the AMC's Western Division, will head up the plans for the 1961 Metal Mining and Industrial Minerals Convention of the American Mining Congress. Assisting him as co-chairman of the General Committee is S. M. Strohecker, Jr., Seattle manager for E. I. du Pont de Nemours & Co., Inc. AMC goes back to Seattle after eight years' absence with memories of a successful meeting there in 1953.

A well-rounded convention program will feature an interchange of views between mining leaders, top Government officials and members of Congress on national policies affecting mineral and metal production. Sharing the spotlight with the policy discussions, the latest developments in operating methods and equipment as applied in all phases of mining will be fully aired at the technical sessions.

The resolutions Committee will again consider Federal programs, legislation and administrative action needed to strengthen domestic mining, and will present a Declaration of Policy for consideration by the industry.

Other convention activities will include an opening reception on Sunday, September 10; a special program for the ladies; a "Potlatch" (salmon barbecue) on Monday evening; the ever-popular Salmon Derby early Tuesday morning; and a boat trip to historic, picturesque Victoria, B. C. on Thursday.

Prominent mining men and women are being asked to serve on committees to assist in the final arrangements for the convention activities. Their efforts, along with the new and improved facilities available in Seattle, will assure a successful convention next September. Plan now to take advantage of this opportunity to stay up-to-date on the industry's technical progress and economic status by joining the mining crowd at Seattle, September 10–14.

(From previous page)

about $1,000,000 and replaces a smaller mill destroyed by fire, incorporates crushing, drying, screening and storing facilities and is said to be the most modern in the perlite industry. It is located on a 2000-acre mining property at the site of what is believed to be the world's largest deposit of commercial-grade perlite.

Perlite processing at the new mill consists essentially of drying crushed ore in two 6-ft diam by 50-ft rotary dryers, which is followed by additional crushing and screening of the product into various grades. Milled perlite is then trucked to the company's blending and loading plant at Antonio, Colo., where it is prepared for shipment.

Johns-Manville entered the perlite industry in 1959 when it acquired F. E. Schundler & Co., Inc.

RADIOISOTOPES CONFERENCE

Advances in the technology of radioisotopes and their potential application in the mining industry will be the subject of a special Conference to be sponsored by the American Mining Congress and the Colorado School of Mines Research Foundation, Inc. in cooperation with the Atomic Energy Commission. More complete announcements will be carried in the February and March issues of Mining Congress Journal. The proposed conference, scheduled to be held in Denver next April, will be of interest to the entire mining industry, including equipment manufacturers, and mineral processors.

ALSO . . .

A short course on computors and computor applications for managerial and technical personnel in the mineral industries will be held at the University of Arizona, April 4–7. It will cover computors and peripheral equipment, introduction to computor programming, mathematical techniques, and feasibility of computor utilization and will emphasize applications in the mineral industries. Application deadline is March 1. Apply by letter to Prof. E. R. Drevdahl, College of Mines, University of Arizona, Tucson, and include participant's name, company affiliation, occupation, and course fee of $100 per person.

MCJ INDEX FOR 1960 NOW AVAILABLE

A complete index of the editorial material published in Mining Congress Journal during 1960 is now being printed. It contains alphabetical listings of both subjects and authors for MCJ Volume 46. If you wish a copy please write to Mining Congress Journal, 1102 Ring Bldg., Washington 6, D. C.

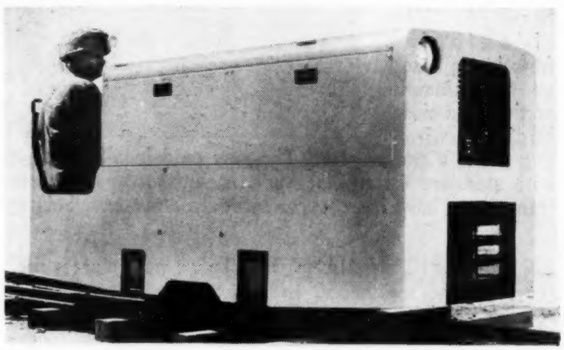
A two-year option on 103 mining claims in the Mount Washington mining district near Ely, Nev., has been acquired by the Anaconda Co. from Mt. Wheeler Mines, Inc. The property, comprising about 2000 acres, has been prospected for tungsten and beryllium in recent years. Anaconda plans underground development to determine the extent of beryllium deposits on the claims.

Federal Resources Corp. has acquired controlling interest in Col-U-Mex Uranium Corp. and has assumed management of the company. Col-U-Mex has uranium mining properties in the Big Indian district of San Juan County, Utah, that are being worked by Standard Uranium Corp. Ore is currently shipped to the Mexican Hat mill of Texas-Zinc Minerals Corp.

An open pit copper mine will be established at Milford, Utah, properties owned by Cerro Verde Mining Co. and presently under lease to Bogdanich Development Co. Bogdanich is reported to have recently reached agreement with Majestic Oil & Mining Co. whereby Majestic is committed to expenditures of $200,000 that will be used for renovating a 350-tpd mill and opening up the Bawana copper deposit. Recent exploration work by Bogdanich has revealed a 300,000 ton sulphide-oxide copper ore body averaging $3\frac{1}{2}$ percent copper. The company anticipates recovery of both sulphide and oxide copper minerals in a 40 percent concentrate.

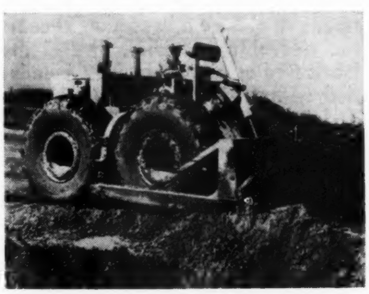
manufacturers forum

A NEW SERIES OF DIESEL MINE LOCOMOTIVES in capacities from 2½ to 25 tons has been developed by the Greensburg Division of National Mine Service Co., 2530 Koppers Bldg., Pittsburgh 19, Pa. These units have air or water - cooled diesel engines driving through a torque converter to a constant-mesh, double - reduction gear type main transmission with power reversing. Only three controls are used—lever for forward - reverse, throttle, and brake.



A design feature is the National Mine Exhaust Gas Conditioner, a unit which allows underground operation without hazard of objectionable smoke or fumes from diesel exhaust. The conditioner cools exhaust gases from as high as 1300° F to a maximum of 160° F, while removing the solid particles of combustion which normally appear as smoke. U. S. Bureau of Mines approval has been granted a number of these locomotives under Schedule 24.

A TRACTOR WITH HYDRAULLICALLY OPERATED ATTACHMENTS has been announced by LeTourneau-Westinghouse Co., Peoria, Ill., as a companion unit to the current C Tournatractor with electrical controls. The new Model C utilizes a high pressure hydraulic system of



5000 psi, and a direct drive, Dynex piston pump. Another reported innovation is the use of two slide valves in the control system, as opposed to the spool or poppet valve. The immediate build-up of pressure, in opening the slide-valve, is said to give faster, more positive response of the blade. The tractor is powered by a GM 6V-71 engine, producing 218 hp, and the transmission is the LW power-shift type, air actuated with torque converter, 4 speeds forward, and a top speed of 18.5 mph. Also new is the integral, 1400 rpm, power take off, for use with the double-drum power-control unit in operation of towed equipment. The over-all length is 13 ft, 6 in., without the blade, and the over-all width is 10 ft-6 in.

TWO FOUR-SPEED AUXILIARY TRANSMISSIONS FOR MEDIUM AND HEAVY DUTY TRUCKS AND TRACTORS have been announced by Fuller Mfg. Co., Kalamazoo, Mich. The Fuller 4-B-73 and 4-B-75 Auxiliaries provide overdrive, direct, low and low-low in one compact, 375 lb unit, and afford gear splitting ratios plus deep reduction. The 4-B-73 is designed for use with engines producing approximately 500-600 lb ft of torque; use of high-capacity bearings permits the 4-B-75 to be used with engines in the 600-700 lb ft torque class. Gears ratios for the transmissions are: Overdrive, 0.85; direct, 1.00; low, 1.24 and low-low, 2.22.

TWO NEW EXPLOSIVES developed for use in seismograph exploration are now available from the Explosives and Mining Chemicals Dept., American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y. They are known as Cyamon S blasting agent and Cyamon S Primer. The blasting agent, a nitro-carbo-nitrate that requires a primer for detonation, is packaged in hermetically sealed cylindrical containers and has a moderate to high degree of resistance to water pressure and stands up well in storage. Each can is threaded to permit easy coupling for forming of column loads. Cyamon S primer can be coupled to the blasting agent through the threaded connections of its cylindrical metal package. The female end contains a recessed well for cap insertion that will accommodate any seismic cap now available. Both primer and blasting agent are available in 2 in. by 1 lb and 2½ in. by 1 lb containers.

AN UNDERGROUND GUNITING RIG can now be rolled by mine and tunnel crews into underground work areas where they can shoot their own concrete into place at the rate of 6 to 12 tph. Designated as Model C-3 UG, the unit was developed by Ridley and Co., Inc., 2217 Pontius Ave., Los Angeles 64, Calif. It is 6 ft high, with a base of only 5 by 10 ft, and

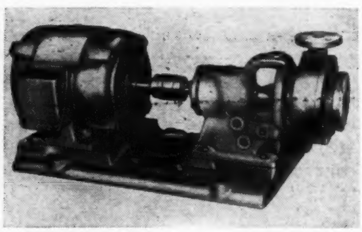
may be mounted on a mine car truck, skids or pneumatic tires. The entire rig may be knocked down to pass through shafts and narrow openings and re-assembled at the job site. Basic components include a paddle type mixer, an elevator, a Ridley concrete gun, and a 100-ft guniting hose complete with nozzle. Air motors powered by mine air lines drive the operating parts.

A NEW COAL LOADING MACHINE with a unique reverse link, double-arm gathering unit has been introduced by Long-Airdox Co., Oak Hill, W. Va. Identified as the 188-3, the machine has a capacity of 12 tpm and is designed for heights of 23½ in. and up. The reverse link motion is said to eliminate "slap" and quick reversal of the arms when over the conveyor, minimizing the scattering of material being loaded.

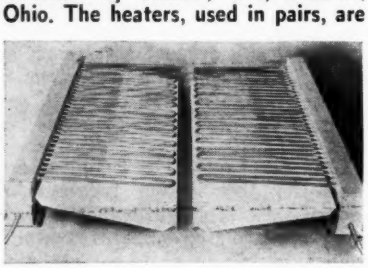
Equipped with a single motor—80 hp a-c or 40 hp d-c—the loader operates by cushioned hydraulic clutch actuation from fingertip controls. Single-reduction, reverse-gear transmissions mounted on each crawler permit independent crawler control. Full motor horsepower is transmitted to the gathering arms and the conveyor through a gear train. Torque limitation is provided by the main drive (slip) clutch.

A THREE-WAY DUMP BUCKET, originally manufactured only for track-type tractor loaders, is now being made for Caterpillar wheel loaders by Libu Shovel Co., AB, Stockholm, Sweden. There are various models of buckets available to cover the complete range of Caterpillar Traxcavators, both on crawler and wheel types. The Libu bucket can be tilted as desired to the right or left, as well as forward. The side tipping function is based on the principle of the open sided bucket swivelling about a center pivot. The new models, which are easily interchangeable with standard Caterpillar buckets without any alteration to the Caterpillar framework, have increased side dump clearance, heights and moveability.

CENTRIFUGAL PUMPS, of the single-stage side suction open impeller type, and having 1-in. flanged discharge and 1-in. and 1½-in. flanged suction connections, are available from Goulds Pumps, Inc., 216 Black Brook Rd., Seneca Falls, N. Y. Designated Model 3199, they are intended to meet requirements in industries where relatively small quantities—up to 155 gpm—of corrosive chemicals or slurries, thick or abrasive, must be handled for heads up to 150 ft. Design includes: 150 lb standard flat faced flanges; top vertical discharge in standard assembly, but with horizontal top or bottom discharge position also available; wide openings that give ready access to gland and stuffing box; impellers that are statically and hydraulically balanced and provided with ejector vanes on back wall to prevent entrance of solid material; and tapped in-and-out openings to seal ring allowing use of clear liquid seal, clear liquid flush or grease seal for solving individual packing problems when pumping slurries. Pumps are available in two sizes, and in bronze fitted, all iron, all bronze, 316 stainless steel and Gould-Alloy 20.

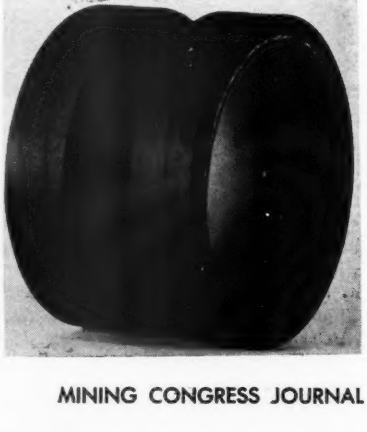


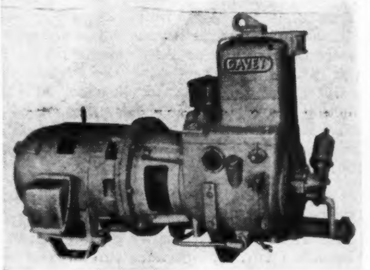
AN ELECTRIC RADIANT HEATER for removing ice, snow, and frozen residual material from railway hopper cars before loading has been introduced by Radcor, Inc., Bradner, Ohio. The heaters, used in pairs, are placed between the rails so as to be directly under the cars. Each unit, designated RUC-32, has a maximum capacity of 32 kw, 240 volts, 3-phase and contains 16 alloy-sheath Chromalox heating elements having threaded-end, water proof fittings. Overall dimensions are 44 in. long by 22 in. wide. The weather-tight framework is made of corrosion-resistant aluminized steel. Each unit is equipped with a ten-ft Neoprene electrical connecting cable.



A NEW LINE OF SUBMERSIBLE, PRESSURE-PROOF A-C MOTORS has been introduced by Reliance Electric & Engineering Co., 24701 Euclid Ave., Cleveland 17, Ohio. They have been especially designed for close-coupling to centrifugal pumps operating in water, oil or liquid chemicals, and are available in sizes from ½ through 40 hp for operation from polyphase power sources, and from ¾ through 5 hp for single-phase connection. The new motors are rated at 55° C temperature rise for 30-min. duty in 40° C air, and for continuous duty in 40° C liquids.

A CONVEYOR IDLER SLEEVE designed to improve cleaning action on belts during return flights has been developed by The Goodyear Tire & Rubber Co., Akron 16, Ohio. The idler sleeves, using two treads, flex the belt evenly as it passes over the idler rollers, and this flexing action separates the caked accumulation from the belt surface and causes it to flake off the belt. The advantage claimed for the Sta-Kleen Dubl-Tread sleeve is that it is able to flex the belt surface into twice as many sections as a single tread. Each sleeve has a channel between the two treads to receive a band that anchors the sleeve to the idler. Sleeves are fabricated of a two-ply duck foundation with treads built up to ½, ¾, or 1-in. wall thickness, and are built to the diameter of the idler roll.





AN OIL-COOLED INDUSTRIAL STATIONARY ROTARY COMPRESSOR, equipped with a new type oil separator, has been announced by Davey Compressor Co., Kent, Ohio. The separator, which is said to greatly reduce compressor oil consumption and oil content in air produced by the compressor, contains an inorganic fiber glass element which accumulates fine particles of oil that drain back to the intake section of the compressor by means of a pressure-reducing oil return valve. The manufacturer states that the amount of oil used by these rotary machines is no greater, and frequently less, than that used by reciprocating compressors. The compressors are offered in 2 to 125 hp sizes, and standard portable machines are available in 60 to 600 cfm capacities.

CATALOGS & BULLETINS

SIX-WHEEL TRACTOR-SCRAPER. *Letourneau-Westinghouse Co., 2301 NE Adams St., Peoria, Ill.* Form No. TP-436 gives considerable detail about LW's 20 cu-yd (heaped) tractor-scraper combination known as Model C Speedpull. Points discussed in this booklet are: net-cost-per-yard for long-haul earthmoving; steering, handling and ground clearance; power-to-weight ratio and speed; loading; traction; durability of performance and accessibility for maintenance; operator efficiency.

CAST TOOTH SPROCKETS. *Link-Belt Co., Dept. PR, Prudential Plaza, Chicago 1, Ill.* Stock sizes of cast-tooth sprockets, said to be availabe for immediate delivery in every major industrial area, are listed in Link-Belt's new 12 page book, No. 2867. Cast-tooth sprocket teeth are ground to fit the chain, and selection data in the new book is based on this "sprocket-to-chain" relationship. There are 132 different chain numbers listed and cross referenced to 48 sprocket lists. The complete range of types and sizes, considering all the many permutations, permits selection from over 30,000 sprockets in stock.

CONE CRUSHERS. *Nordberg Mfg. Co., Milwaukee, Wis.* "How to get the most from your Symons Cone Crusher" has been prepared to aid users of this equipment to obtain best performance and efficiency from their crusher, and discusses some of the common problems and faults encountered in crusher operation. Installation photographs help illustrate the points made.

YIELDABLE ARCHES. *Advertising Dept., Commercial Shearing & Stamping Co., 1775 Logan Ave., Youngstown 1, Ohio.* Catalog 300-C3 on Commercial TH yieldable arches describes the principle of these arches for underground support and how they work, and lists six exclusive Commercial TH yieldable arch features. It also includes complete technical information on segment and connection details, typical arch shapes, accessory details, dimensions, and physical properties of Commercial lagging used in conjunction with the arches.

ROLL CATALOG. *Barclay Machine, Inc., 784 Euclid St., Salem, Ohio.* Bulletin No. 601 describes and illustrates the construction of rolls with stub shafts and through shafts; rolls with fabricated bodies and cast bodies, alloy rolls, stainless steel rolls, rubber covered rolls, plastic covered rolls. Designs for use in all phases of ferrous and non-ferrous strip handling and processing.

FLEXIBLE SHAFT HANDBOOK. *Dept. P., S. S. White Industrial Div., 10 E. 40th St., New York 16, N. Y.* The revised Fourth Edition of the S. S. White Flexible Shaft Handbook presents a simplified approach to the selection of flexible shafting through Standard, Pre-engineered, or Custom-designed flexible shafts. Full descriptive material is provided, including charts, tables and drawings. Information is also given on an engaging system based on integral formed square drives, and the Series 7 (remote control), and Series 9 (power drive) flexible shafts. Described in detail are the advantages of flexible shafts, their function, successful applications, and fundamental information on standard power drive and remote control shafts.

(More next page)

—ANNOUNCEMENTS—

John T. Ryan, president, **Mine Safety Appliance Co.,** has been elected to the board of directors of **International Minerals & Chemical Corp.**

Robert F. Stewart, assistant general manager, **Western Precipitation Division, Joy Mfg. Co.,** was recently named vice president and general manager of the division.

John Maher, president, **Reed Roller Bit Co.,** has resigned. **Ray O. Shaffer,** chairman, will temporarily assume the duties of president and chief executive officer. Maher will remain on the company's board.

Eugene P. Berg and **Ernest S. Everitt** were recently elected to the board of directors, **Bucyrus-Erie Co.,** South Milwaukee, Wis.

Berg, previously general manager of all Chicago operations of the Link-Belt Co., joined Bucyrus-Erie last year in the capacity of executive vice president. Everitt, a 33-year veteran with Bucyrus-Erie, is presently managing director of Ruston-Bucyrus, Ltd. (an affiliate company in Lincoln, England). Everitt's previous positions with the company were in the export department and in sales.

Hamilton M. Ross has been elected a vice president of **Hewitt-Robins, Inc.,** with responsibility for the company's contract engineering operations in this country and abroad. He will be assisted by **Martin Vander Laan,** who has been appointed director of engineering sales, with responsibility for world-wide sales of bulk material handling systems.

Ross, who joined Hewitt-Robins in 1941 as an engineer, will be succeeded as manager of the Robins Conveyors Division, Passaic, N. J. by **Norman M. Godfrey,** who has been manager, since 1951, of the company's eastern sales region, headquartered in New York City, and who has been associated with Hewitt-Robins since 1937.

Vander Laan has been associated with Hewitt-Robins for 25 years in various capacities having to do with the design, manufacture and sale of material handling systems.

Link-Belt Co. has established an International Division, with headquarters in the company's executive offices in Chicago. **Donald E. Thal,** with 24 years of service with Link-Belt, has been appointed general manager of the new division, and will administer the company's overseas activities, outside of the United States and Canada. He has been general manager of its Pacific Central Division, with headquarters at San Francisco since 1954, and has occupied a succession of management positions in engineering, sales and manufacturing administration for the company.

Lee-Norse Co. has licensed Mavor & Coulson, Ltd., of Glasgow, Scotland, as an overseas manufacturer and distributor of its mechanical mining equipment. The license covers sales in all parts of the free world, with the exception of Australia, New Zealand, Japan, North and South America. Activities in these areas are covered directly by Lee-Norse. A production pilot model of the miner has already been shipped to the company in Scotland.

(from previous page)

LOCOMOTIVE WIRE AND CABLE. *The Okonite Co., Subsidiary of Kennecott Copper Corp., 220 Passaic St., Passaic, N. J.* This bulletin describes and discusses Okonite's line of wire and cable for diesel electric locomotives and includes dimensional charts for both braided and non-braided constructions. Okonite DEL cable is described as a non-flammable, oil, chemical and moisture resistant cable designed for use on generators, motor leads, power and control jumper lighting systems, controllers and cab signal wiring.

RESEARCH AND DEVELOPMENT. *Advertising Div., Caterpillar Tractor Co., Peoria, Ill.* Form No. DO23, entitled "Looking Ahead," discusses the research and development activities of the Engineering Dept., Research Dept., Products Div., and Market Div. of Caterpillar.

HARDROCK DRILLING. *Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17, N. Y.* SP-3286 is a 16 page bulletin describing in detail, with illustrations, CP compressor and drilling equipment. Mentioned are crawler-mounted rotary drill rigs, Tracdrills, IN-Hole percussion drills, Air-Blast Bits, diamond drills, sinkers, demolition tools, stationary and portable compressors, and sump pumps.

SEAMLESS WELDING FITTINGS AND FLANGES. *Tubular Products Div., The Babcock and Wilcox Co., Beaver Falls, Pa.* Bulletin FB-502A covers seamless welding fittings, and flanges in carbon, alloy and stainless steels. The booklet includes charts of standard sizes and schedules according to ASA B36.10 and ASA B36.19, and also has a comprehensive breakdown of dimensional tolerances, illustrations of the most commonly produced fittings and flanges, and a chart of available sizes and types.

AIR COMPARISON PYCNOMETER. *Technical Information Dept., Scientific and Process Instruments Div., Beckman Instruments, Inc., 2500 Fullerton Rd., Fullerton, Calif.* Beckman Model 930 Air Comparison Pycnometer is described in Bulletin 786. This instrument makes possible rapid, nondestructive volume measurements for density and porosity determinations of irregular, powdered and porous solids. The device is hand operated and requires no power source. Among others, applications of the Pycnometer includes ore sample and mineral purity evaluation, density measurements in engineering materials, and porosity calculations on bearing metals.

SLINGS, RINGS, LINKS AND HOOKS. *Wire Rope Div., Jones & Laughlin Steel Corp., Muncy, Pa.* Specifications and working load limits for J&L line of alloy chain slings, rings, links and hooks is discussed in this bulletin. It includes a page on ordering and selecting the correct chain slings as well as an explanation of the use and maintenance of these units and their attachments. Listed are four points of a good periodic inspection program.

ELECTRIC POWERED BORING UNIT. *KA–MO Tools Dept., Kwik-Mix Co., 235 West Grande Ave., Port Washington, Wis.* The E300 unit's boring range varies from 40 ft of 48-in. diam hole to 240 ft of 12-in. diam hole in vertical, horizontal, or angular boring. The bulletin discusses this and other features of the unit, which consists of a 440-volt, 3-phase, 60-cycle squirrel cage motor; two different gear ratios; 63 to 1 and 105 to 1; a protective slip clutch; a maintenance swing thrust bearing on reduction gear; power or gravity auger feed; and control panel with remote single level control. On-the-job applications of the E300 are shown.

LOADERS AND FILTERING EQUIPMENT. *The Eimco Corp., Salt Lake City, Utah.* The booklet, "Quality Products from Eimco" (AP-20), includes pictures and short descriptions of the company's line of tractors, loaders, mining equipment, process and filter equipment and some of the products of the Eimco Foundry division. Also included are aerial views of the company's facilities in Salt Lake City and research activities in Palatine, Ill.

STEEL CASTINGS. *Alloy Steel & Metals Co., 1848 E. 55th St., Los Angeles 58, Calif.* Bulletin No. 300 covers design advantages and engineering properties of "T-1" alloy steel castings, plus welding and machining data. Alloy Steel & Metals Co. reports it is the first foundry licensed by U. S. Steel to make these castings.

SWITCHES. *Micro Switch, division of Minneapolis-Honeywell Regulator Co., Freeport, Ill.* A circular is available from the Micro Switch division describing an adjustable pulse switch, central neutral limit switch and proximity switch. Illustrated are a wide variety of limit switches, explosion-proof switches, basic switches, pushbutton switches, mercury switches and toggle switches for use on machine tools and other industrial equipment.

Index to Advertisers